LOS ANGELES MUSEUM
EXPOSITION PARK

LIVING AFRICA

VICTORIA FALLS OF THE ZAMBESI.

LIVING AFRICA

A Geologist's Wanderings through the Rift Valleys

BY

BAILEY WILLIS

Research Associate
Carnegie Institution of Washington

ILLUSTRATED WITH
PHOTOGRAPHS AND DRAWINGS, BY THE AUTHOR
AND MARGARET D. B. WILLIS

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To

MY MOTHER

WHO SET MY FEET UPON THE TRAIL

AND

MY WIFE

WHOSE SPIRIT CHEERED ME ON

THIS BOOK IS DEDICATED

PREFACE

DURING the past decade Carnegie Institution of Washington has promoted a program of research in seismology which has included investigations into the causes of earthquakes in various countries. Chile, Japan, the Philippines, New Zealand, and Palestine have been visited and a report on conditions of earthquakes in Chile, the first of a proposed series, has been published. Central Africa, a region in which earthquakes occur frequently, invited a similar study.

The earthquake region of Central Africa corresponds with the great lake district in which the Nile and Congo take their rise. Lake Victoria Nyanza, a shallow water body branching into many inlets, is surrounded at some distance by lakes or depressions too dry for lakes, which are characteristically long and narrow. The long, narrow depressions are known as rift valleys because they are believed to represent fractures or rifts in the Earth's crust. Geologic opinion is not agreed as to the nature of the fractures or of the forces that operated to produce them.

In course of the investigation of earthquake causes it has been recognized that the kind of shock experienced in a district depends upon the character of any fractures

which traverse it, the manner of movement of large masses, and the direction of pressures. It thus appeared that a study of earthquake conditions in Africa could have a bearing on the origin of the rift valleys.

The rift valleys are also related apparently to volcanic activities, past or present, in certain areas, and this fact broadened the scope of the proposed survey to include eruptive phenomena.

Dr. N. L. Bowen, of the Geophysical Laboratory of Washington, and I were accordingly authorized to proceed to Africa to carry out the research. This we did during the latter half of the year nineteen twenty-nine. As a specialist in volcanology Dr. Bowen directed his steps chiefly to volcanic regions, while I pursued a more general study of the entire area. We therefore traveled together during a few weeks only. The total length of rift valleys examined exceeds fifteen hundred miles and my journeys in Africa by rail, steamer, automobile, or on foot covered more than six thousand miles.

While the proposal to study the rift valleys as a part of the program in seismology was being considered, our British colleagues in East Africa were consulted, and they very cordially responded by inviting me to be their official guest. Mr. E. J. Wayland, Director of the Uganda Geological Survey, and Dr. E. O. Teale, Director of the Tanganyika Geological Survey, organized parties to conduct me and generously made possible excursions to areas that must otherwise have been entirely beyond my

reach. Similar courtesies were extended to Dr. Bowen by Mr. Wayland.

English and Belgian officials gave every possible assistance in Tanganyika, Uganda, Kenya, Sudan, and Congo territory and we everywhere met with that cordial hospitality which creates friendship. Our thanks are due to many friends, among whom I would not omit the natives who helped us to carry on even though they could not understand our purpose.

I arrived at Dar-es-Salaam on May 22, 1929, and proceeded directly to Dodoma, where Dr. Teale was awaiting my arrival to enter upon a joint trip through eastern and southwestern Tanganyika Territory. This occupied a month. Having returned with Dr. Teale to Dodoma I left there on June twenty-fifth with Mr. G. M. Stockley, Field Geologist of the Tanganyika Survey, to undertake a foot safari in the Livingstone mountains in southern Tanganyika, above Lake Nyasa. We carried out our purpose and parted at Mbeya on July sixteenth, Mr. Stockley returning to Dodoma, while I went by motor car across Northern Rhodesia to Broken Hill and thence by train to Pretoria to attend the International Geological Congress. Coming north again late in August I stopped at Victoria Falls, whence I proceeded via Elizabethville and Albertville once more to Kigoma on Lake Tanganyika. Dr. Bowen had joined me at the Congress and at Kigoma we were met on September ninth by Mr. A. D. Combe, Field Geologist of the Uganda Geological Survey, who had made arrangements for our further journey to Lake

Albert and Entebbe on Lake Victoria. This trip took us by way of Lake Kivu to the Mfumbiro volcanoes, whence Mr. Bowen went on eastward while Mr. Combe and I turned toward Mt. Ruwenzori, Fort Portal, and Lake Albert. On this route steamers or motor cars were used where practicable, but the greater part was made on foot and occupied two months. We reached Entebbe on November sixteenth and after spending a week with Mr. Wayland I went on to Nairobi in Kenya colony. A month was spent in excursions from Nairobi to various sections of the Great Rift valley of Kenya and Tanganyika, including the northern district about Lake Baringo, the central portion from Nakuru to Lake Natron, and the region of the Giant craters in the southwest. The objects of the journey having been accomplished I left Nairobi by motor car on December twenty-second and drove to Juba on the Nile, whence I took the steamer to Khartoum, en route home.

The narrative of my wanderings in Africa which is here presented comprises the substance of letters written during the journey and is accompanied by suggestions of the scientific observations and their meaning. A fuller monographic discussion of the geology will be published by Carnegie Institution of Washington.

BAILEY WILLIS.

STANFORD UNIVERSITY,
April, 1930.

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THE QUESTION

"MANY years ago," said Dr. Edouard Suess, the Nestor of European geologists, chatting with me in 1912 at his Hungarian home, "three young men met fortnightly at the Gasthaus zum rothen Hahn to discuss the object of their studies, geology, over a schoppen of beer. It chanced that one of the number brought an English work which had recently come into his hands, and proposed that they should translate it into German, it being in his opinion the most important contribution to geology that had appeared up to that time. It was Lyell's 'Principles.' The other two agreed. They divided the task between them and promised to meet in two weeks with their translations. When they came together again the one who had introduced the 'Principles' to their attention had completed his part of the work. His name was Ferdinand Von Richthofen. He subsequently daringly explored China and became the authority on the geology of that great empire.

"Another had partly accomplished his share. He was F. von Hochstetter, who in later years explored New Zealand.

"The third had made no translation. He held that Lyell's basic principle, the uniformity of natural processes under nature's laws, was not demonstrated; that our yardstick of

observation was too short to justify that inference; we could not judge the Past by the Present.

"He," continued Suess, looking affectionately at his wife and daughter, "stayed at home, but traveled in the works of others who described for him the lands they saw."

Thus did the greatest compiler, the most widely read geologist, the most beloved scientist of his day, state the habit of mind with which he wrote the "Face of the Earth," *that great work which is the compendium of other men's observations.*

Suess felt no urge to travel. He built a world of his own from the accounts of explorers, and a very complete world it was, though in some respects an artificial one. Among the conditions imposed upon his ideal globe was one that he observed in the basin about Vienna. It is by no means unusual that a geologist's reasoning is narrowed to his environment. The Viennese basin is a sinking region deeply filled with wash from the hills. Gravity causes this subsidence. Gravity is the all-pervading force. Gravity, reasoned Suess, is the strongest possible force; therefore it is impossible that any part of the surface may be or may have been raised against gravity. Hence universal subsidence is the cause of the differences of level we observe on the earth's surface, whether of ocean basins or continental plateaus.

The elevation of the Alps is so obvious that an exception was admitted for that and for similar mountain chains where the effects of horizontal compression are evident.

Direct vertical elevation of a continent or of any large part of one was, however, ruled out.

When Suess first formulated this idea there was no decisive evidence to the contrary. His authority, based upon his wide reading, his sincerity, and his charming personality, gave it great force. Subsidence of the earth's crust, expressed in German by the word "Einbruch" *and in English by* "collapse" *or* "foundering," *became a fundamental principle of a very influential school of European geologists, and it still remains so.*

During the last third of the nineteenth century there grew up in America a branch of geologic investigation known as "physiography." *Its essential purpose was to interpret the forms of a landscape, to read in the characters of hills and valleys as in the words of a printed page the history of their past. How did they come to be what they are?*

Did you ever ask yourself: Which is older, this strong-flowing river or yonder mountain range through which it winds? The answer will lead you far back in the history of your own land, and more often than not you will learn that the great rivers have persisted during the elevation and wasting of more than one generation of mountains or plateaus.

The central idea of physiography, the leveling of hills by rills and rivers, was first suggested by the Scotchman, Hutton, about 1785; but it lay fallow till about 1870 when the importance of the processes by which wind and water sculpture the land was impressed upon Powell and Gilbert

by their observations of the stupendous work of erosion in the Grand Canyon of the Colorado and elsewhere throughout the Far West. The science of physiography sprang from their eager explorations. It was developed by W. M. Davis of Harvard, their disciple.

After a visit to Turkestan in 1903 Davis challenged the principle of general subsidence of the earth's crust. He reasoned from the flat plateaus of Central Asia that they had been planed off by rivers when their surfaces were near sea level and that they had been elevated many thousand feet, against the attraction of gravity. Davis's argument appeared unanswerable. It came too late, however, to influence Suess. I spoke of it once in converastion with him. He shook his head; at the age of seventy-six he was still reading, still perfecting the description of his earth. Smiling his gentle smile, he answered: "I am too old to take up new problems. I must finish my work." He left it very complete, but the work of a great thinker like Suess is never finished. He died thinking.

In building his ideal world on the pattern of the existing one Suess could not, of course, omit Africa or the adjacent lands. He read of the existence in Eastern Africa of remarkable valleys, not excavated as valleys usually are by rivers, but formed apparently by some disruption of the earth's crust. A similar valley, the Dead Sea trough, exists in Palestine. In driving from Jerusalem down to Jericho it gives one a little shock to continue past the sign that says: Sea Level. We generally stop our motor at such a point,

but here we continue to descend for some twelve hundred feet to Jordan's plain, and the bottom of the Dead Sea lies much deeper.

What could have depressed a segment of the crust to half a mile below sea level within a continental area like Arabia? Gravity, of course, replies confidently a geologist of the subsidence faith, though his lack of consideration of the foundations may trouble an engineer.

The Dead Sea trough extends to Akabah, the port on the Red Sea that Lawrence took in the rear. Some hundreds of miles farther south the Red Sea basin, which may be regarded as a depressed section between Arabia and Africa, connects with a lowland that runs southwest past Abyssinia and forms a natural route into Central Africa. Asiatic peoples have followed it and would have done so more often except that warlike tribes and waterless plains around Lake Rudolph have made it difficult. Lake Rudolph is the northernmost of those peculiar East African valleys which Suess knew by travelers' descriptions, and they extend, though somewhat disconnectedly, to Lake Nyasa, four thousand miles south of the Jordan. Here then is a remarkably long chain of depressions of unusual character. Suess grasped it in its entirety; he considered it a split, a rift in the earth's crust, and he thus opened up the question: how could such a rift be made?

Before we can attack that problem we must bring into action another distinguished geologist, Professor J. W. Gregory of the University of Glasgow. An intrepid Scot, he

is a great explorer; a speculative scientist, he is a follower of Suess; but he has always desired to meet Nature face to face. In 1893, as a young man, he examined the length and breadth of the rift valley in Kenya from Lake Magadi to Lake Baringo. At a time when rhinos, buffaloes, and lions were still numerous and the fighting Masai were quick in offense, he went accompanied only by negro porters, and he now remarks apologetically that geologizing with a hammer in one hand and a rifle in the other is difficult. One might forgive a man an error of observation under the circumstances. One would regret to differ with a colleague who had demonstrated such courage and enthusiasm. It is a pleasure to agree with him. After traversing the same ground under far more favorable conditions for observation, I find as he did that the Eastern rift valley is a crack, an effect of tension in the earth's crust.

We shook hands on that agreement after a long talk in London. But in taking off from the firm field of observation into the atmosphere of theory we parted. Gregory went up into the thin medium of speculation, while I stayed nearer the ground. We see the cause of tension from different points of view.

Gregory agrees with Suess that there once was a continent, known as Gondwana land, which occupied the northern part of the Indian Ocean and connected Africa, India, and Australia. Subsiding, it tore Africa and Arabia, producing a great rent from the Zambesi to the Jordan. In Gregory's opinion the rift valley is a part of that rent.

But was there ever a Gondwana land? There is no doubt that land connections existed between now widely separated continents and, like the lost Atlantis, must have sunk beneath the ocean waves. Where were the ocean waves, where the water, if the basins were solidly filled? And how does a continent founder? What happens to its support? How do the foundations in the solid earth get out from under? Where does the rock go?

Unable to answer these questions, I have turned to a modern example of continental connection as a guide to past events. It is well known that North and South America were until recently separate continents. They are now connected by an isthmus. The erection of an isthmus, like the elevation of a mountain range, is an effort well within the power of earth forces. It has also happened that the foundations of ancient denuded ranges have subsided deeply, and, while such an event, like the foundering of a continent, is difficult to explain, it is on a relatively small scale. It has therefore seemed reasonable to search the ocean floors for shallows that might represent sunken isthmuses between South America, Africa, India, Australia, and Antarctica. Such shallows do exist, and thus make isthmian connections appear less improbable than vanished continents.

Regarding the Gondwana continent as an interesting bit of fiction, I cannot agree with Gregory that the foundering of that land caused the splitting of Africa. And yet I have not been able to explain the apparent split. The

problem fascinates because it evades solution. It is for me an advanced problem in a long course of similar studies that during half a century have led me far and wide. Inspired by the "Mechanics of Mountain Building," that great work of the enthusiastic Swiss geologist, Albert Heim, I dared to think I might some day come to understand the mechanics of mountain structures, the causes of continents and ocean basins, the working of the earth itself.

When I was a college student horizontalism was the established geologic faith. It was well known that the Alps, the Appalachians, and many other great mountain ranges had been piled up by horizontal compression. Experimental studies proved the effects. All my early experience was in studying folded structures. I became a convinced horizontalist.

G. K. Gilbert, a philosophic geologist of far ranging thought, turned my attention to continental problems in distinction to those of mountain chains. In each continent there are great masses which, since the beginning of things as they are, have tended to stand high. Dana long ago recognized them as continental nuclei. Their modern name is "positive element." *They are positive because they insistently tend to rise, vertically, whereas surrounding areas within the continent tend to sink.*

These vertical movements have been characteristic of continental bodies during their existence. The masses they affect are stupendously large, as we estimate them. Mountain chains are relatively small and the effects of horizontal

pressures are comparatively local as well as occasional. Pondering these things I acquired a leaning toward verticalism, a belief in the action of vertical forces. But I could not explain them.

Chamberlin, the most profound thinker of our times on the origin and growth of the earth, turned my thought to deeper things. What we see on the surface is founded in the depths. The procession of geographies, that is, of changing aspects of lands and seas on the surface of the globe, reflects the action of internal forces. In the search for the initial force, the ultimate cause, whether of earthquakes, volcanoes, mountain ranges, plateaus, continents, or ocean deeps, we must go down, down, below the outer shell, through the inner spheres to the very core. Following the lines of research suggested by that great master of our science, I became a profundist; and I am still asking: Why? Why do the forces within the earth warp its surface? What forces are they? Through what mechanisms do they work?

This, however, is clear. However profound the sources of power, its manifestations at the surface are to be recognized through the development of ocean basins and through the history of continents. Continents alone are accessible to study. Africa is perhaps the most typical continent of all.

It has been a long trail, though in pleasant companionship with great thinkers. The basic conceptions have changed with advances in our understanding of Nature. Half a century ago we thought we knew that the globe was a molten sphere with a thin crust. We now know that it is

essentially solid, for it transmits elastic earthquake waves. We thought it might be compared to a wrinkled apple. There is now no certainty that it is shrinking. It may even be expanding. The great, primal, all-pervading force is the attraction of gravity. We attributed, and many still attribute, the development of the surface features of the globe wholly to that agency. Heavy masses ride low, lighter masses ride high; hence continents and ocean basins. The idea seems sound in the main, in the large, but there are many minor features, such as mountain ranges and volcanoes, that do not fit the explanation. There is some disturbing activity, some Puck, a tricky sprite that is forever playing with the established order of things. I think it is heat. I regard the earth as a heat engine, but I do not know how it works.

Africa is not only a very large continent; it has through all its existence been a very positive continent, its vast central plateaus standing persistently above sea level. This consistent action of the sustaining force, whatever it may be, has in recent millions of years been modified or accentuated in some way that has resulted in the formation of the rift valleys.

I do not know, of course, what a rift valley is. That is just the question. It may be agreed, however, that a rift valley is one that has been formed by some dislocation of the earth's outer shell. It is, therefore, to be distinguished from the common type of valley that includes all those worn by running water. The ideal rift valley is bounded by cliffs, repre-

senting breaks along which one side has gone down or the other has gone up. Where there are two parallel breaks or rifts a little distance apart and the strip between them is relatively low, the rift valley is ideally complete. It remains to be seen how nearly the facts agree with the ideal. In the meantime we may look over the map to see where a journey through the rift valleys of Africa will lead us.

There are two great zones of fracture in Eastern Africa which are more or less continuous rift valleys or chains of rifts. They form two arcs facing one another, the Eastern and the Western rift zones.

The Eastern rift zone, which comprises the Great Rift valley described in detail by Gregory, begins at the north with Lake Rudolph. Lakes Baringo, Naivasha, Magadi, and Natron lie within it. South of Lake Natron it branches, continuing southward past Lake Manyara and also westward past Lake Eyasi. It does not extend, as Suess supposed, to Lake Nyasa, the plateaus of southeastern Tanganyika intervening. The total length of the depression is about six hundred and fifty miles and its width from twenty to thirty miles. The rocks along its course are lavas, some of them spread widely over ancient gneisses, some of them erupted from volcanic cones.

The Western rift valley extends from Lake Albert in the north to the southern end of Lake Tanganyika in the south, a distance of eight hundred and fifty miles. It is on the whole less simple than the Eastern rift valley. South of the sharply defined trough of Lake Albert the bulk of Ruwenzori,

a large mountain block, has been forced up to sixteen thousand feet above sea. No subsidence there, yet it stands within the rift valley where the sides spread far apart. South of Ruwenzori we pass Lake Edward and come to a volcanic range, the Mfumbiro, whose position on an east-west line in a north-south rift valley is as eccentric geologically as its name is to an English tongue. Some of the Mfumbiro volcanoes are old and dead, others young and active. The latter contain molten lava. An eruption in 1905 materially altered the coast at the northern end of Lake Kivu, continuing the process of damming up the valley down which the waters once flowed northward. But the lava dam had been established long since. The lake had filled, had overflowed toward the south, and so become tributary to Lake Tanganyika. The gorge of the stream that was thus born, the Ruzizi river, flows in a superb young canyon, but not in a rift valley.

If the advocate of an Africa torn apart along the rift valleys has become somewhat discouraged on looking at Mt. Ruwenzori and Lake Kivu, he may take heart on sounding Lake Tanganyika. It is four thousand feet deep. Its bottom is sixteen hundred feet below sea level. Since it is five hundred miles long and relatively very narrow, it is a perfect crack, in appearance quite as good a one as the Dead Sea in Palestine. Appearances may deceive, but Tanganyika and the Dead Sea are the best examples the tensionist can cite.

It is a part of the contradiction which gives interest to the rift valley problems that the only thorough study yet made of any part of the Western rift valley led to the conclusion that compression rather than tension had produced that section.

The section studied was the Lake Albert trough and Mt. Ruwenzori. The geologist was E. J. Wayland, director of the Geological Survey of Uganda, a thoughtful Englishman of independent mind. It would not be difficult to interpret the steep escarpments that face each other across Lake Albert as fractures between which a keystone had sunk down. That is accepted rift doctrine; it requires that the sides be pulled apart. But Wayland could not thus account for the high plateaus between which Lake Albert lies, nor for the elevation of Mt. Ruwenzori, a mountain block which is part of the same zone. The plateaus and Ruwenzori have been forced up. The block under Lake Albert, he reasoned, has been forced down. The whole great structure is a result of horizontal compression acting on wedge-shaped masses. The upper ones have risen on inclined planes; the under ones have been depressed by the weight and pressure.

Gregory and Wayland differ. One would pull the earth's crust apart, the other would press it together. They have studied different regions. They are both experienced and able geologists. Supposing both were right. What then could have been the movements of the outer shell that had stretched it here and compressed it there? Have we to deal with two distinct effects or with related disturbances through

which a common cause for these horizontal movements, for vertical displacements, and for volcanic eruptions may be discovered?

The arcs of the Eastern and Western rift valleys curve about Lake Victoria Nyanza in a curiously suggestive way. They seem to tantalize us, not proclaiming clearly "We are one," yet hinting that if all the relations were known they would be found to be elements of one great structure.

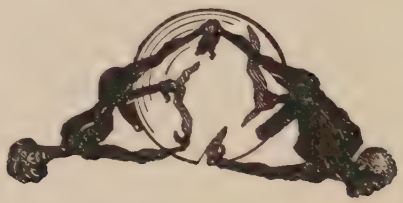
The superficial form of the structure is a saucer into which the clouds have spilled Lake Victoria. The clouds spill their waters all over the basin and the rivers run toward the pool in the middle, the lake. During hundreds of years of heavier rains the pool was larger than now. Strongly marked terraces a hundred feet above the water show its one-time level.

There are hints of older scenes, before the basin was formed, when the rivers flowed westward to the Congo. Their channels were the same as now but the grades were different. Rivers rising east of Lake Victoria flowed across its site, westward across the line of the Western rift, down the Congo slope to the Congo river, an even mightier river then than it is now. You may see the evidence without going to Africa. Look at the streams west of Lake Victoria, those that flow into it from the west. Running east they counter the entering currents of their tributaries, they flow upstream in their old channels, though downgrade as the channels are tilted today. They have been reversed in their flow.

Lake Kioga, north of Lake Victoria, is a river valley that has been flooded, the main stream and all its tributaries, flooded by being tipped backward. Helplessly held back, the old Kioga river lay there till the Nile captured it. Then the Nile extended its domain to Lake Victoria, which had been formed by that time, and thus gained control of the wide watershed that had been the headwaters of the Congo. Had the Nile not thus gained strength to cross the thirsty sands of Libya it could not have built the delta into the Mediterranean; there would have been no Egypt; and the history of the human race would have taken a different course.

The reversal of the rivers that flow into Lake Victoria from the west shows that the levels have changed recently; that is, within the last million years or so. The central area, now under the lake, has sunk, or the rim that is outlined by the rift valleys has been raised relatively. Perhaps there has been sinking here and rising there simultaneously. The movements are probably still in progress.

These are vertical ups and downs. Gregory and Wayland have found evidence of horizontal displacements. Africa is warping, heaving, changing—very slowly, to be sure, but no less evidently. The great question mark stamped on the face of Africa challenges us. Let us go.



I

Entering Africa

THE journey over, the work begins. The little coasting steamer, *Dumra*, from Mombasa touched at Zanzibar last evening and then steamed across to the mainland. At daybreak we threaded a very narrow, crooked channel through the coral reefs and entered the little palm-fringed bay that is the harbor of Dar-es-Salaam, the Haven of Blessing.

A kindly port it has been to me. An official guest, I have been received with English courtesy and have discovered friends. The immigration officer dispensed with formalities. The customs officer gathered my baggage. Mr. Gilman, Chief Engineer of Railways, took charge of me, and he and Mrs. Gilman made their home mine until the departure of my train, except for the hour with Governor Cameron. The Governor held my letter of introduction unopened in his hand the while he said laughingly, "I know all about you." I wondered if he did.

Into the few hours of the morning were crowded vital impressions of men and affairs, giving fresh interest to Africa. Of geology there was little talk, but of adminis-

tration, development, and the race problems all that the minutes permitted.

After lunch I was sped on my way up country to Dodoma, the headquarters of the Geological Survey. It was an overnight journey by rail. We passed the coastal plain of palms and bananas. The moon, which the night before had wasted its light among the dark shadows of the devil's stronghold, old Zanzibar, now lit up for me the African bush: plains or slopes, grass or thorn trees.

In the restaurant car a fat Greek woman related her experience of a week past when she had been driving home with her husband from the station at which she left the train. "It was night, of course, and there were two great lions in the road! Oh, my God! The male he looked and growled and jumped away, but the female, she came after us!" "Did you stop?" "Oh, my God! No-o-o!"

So this is Africa!

The engine labored on an upgrade. The moonlight was reflected from mica in the rocks of a ravine. We had reached the real mass of the continent, the ancient foundation rocks. We were climbing to the plateau.

The railroad problem ran in my mind, the planning of transportation routes for the Territory of Tanganyika. Gilman had sketched its outlines during our brief hours together, and I was deeply interested in throwing this actual situation against the background of my experience of fifty years ago. At that time the Northern Pacific Railroad was being projected beyond the great plains

across the Rocky Mountains to the Pacific coast. Under the far-seeing policy of Henry Villard and the direction of Raphael Pumpelly a number of young geologists were employed to ascertain the freight resources of different sections, and I as one of them became familiar with the pros and cons of railroad strategy.

It is Gilman's purpose to build the railway that will give the country the best service at the least cost, rather than that which will at any cost satisfy the personal wishes of pioneer settlers.

To climb to the plateau means a railway costly to construct and expensive to operate. Not to climb means low cost of construction and operation. The planter wants the track on the plateau, past his coffee plantations. He exerts political pressure. He enlists public sympathy regardless of available revenues. On the other hand, the engineer and financier say: "Lay the route along the foot of the rise. Feed it by means of auto trucks on highways or by branch lines as the traffic grows. Expend the meager revenues judiciously while enterprise is young and the economic future veiled in uncertainty."

Certain facts are already established. The Germans built this trunk line from Dar-es-Salaam up to and straight across the plateau, eight hundred miles, to Kigoma on Lake Tanganyika. Thence steamers connect with villages on the five-hundred-mile-long lake and very directly with the rails of the Belgian Congo at Albertville. Kigoma and Dar-es-Salaam have thus become the ports for all

the freight of the eastern Congo. The wharves are piled high with railroad equipment, mining machinery, automobiles, and goods of all kinds used in the development of that country. The copper from the mines of Katanga is coming out this way. As one looks at the piles of freight one realizes that the shortest route to the seaboard, which is everywhere needed for African raw materials, lies east and west, away from the great north-south Cape-to-Cairo route, the ideal of British policy.

Gilman's problem involves these international factors as well as the territorial needs. In planning new lines or branches he has to consider the maintenance of that which is, as well as the utility of that which is proposed. Imperial policies have to be considered, but petty politics may prevail.

Meantime the train continues to climb through the night.

Morning dawns upon a desert—not a North African desert of moving sand dunes and swaying camels; rather a semidesert like that of the southwestern United States, home of the Apache there, of the gliding leopard here. It is a hard plateau stretching flat to the level horizon, except where residual hills break the surface. It is baked soil. Grasses turn brown in the sun and burn up at a spark, but their fine roots penetrate every capillary of the earth and, drinking as soon as a shower falls, send up moisture to the sprouting green. Thorn trees spread their crooked branches and thin mimosa-like foliage

sparsely, like mesquite in Arizona. Flowers are few and withered. It is autumn in the month of May.

Through this scene we approach Dodoma, the nominal capital of Tanganyika Territory. Houses and English inhabitants are few, fortunately, for there is not water for many baths.

The town was founded by Germans. A flowing spring sufficed to distinguish the locality. The east-west trek here crosses the north-south, and there is no better central site for a seat of administration. The reservoir now being built on an intermittent stream will increase the possible water supply, but there is danger that its sufficiency during a sequence of wet years may lead to developments beyond its capacity after a dry year or two, as has so often been the experience in semi-arid regions. A few railway officials, the officers of the Geological Survey, a Greek hotel keeper, Indian storekeepers, and negroes constitute the population. There is no bank nor commerce. Dodoma has but a squatter's title to the position of capital of the territory.

Dr. Teale met me. Wiry, energetic, his dark hair slightly gray, he has happily withstood many years of African service on the West Coast and in Portuguese East Africa. Although the calf of one leg was shot off by a careless gun bearer, he carries on vigorously. He does not spare himself or others in field work; but I can imagine that his kind interest in an ambitious subordinate might restrain him from judicial severity as

director. His power lies in his ability to inspire enthusiasm.

We met first in Sydney, Australia. Teale was in haste, about to sail. Introductions and exchange of ideas did not occupy twenty minutes. But there we forged the link of friendship which drew me to Tanganyika as his invited guest, and I look forward to the weeks of companionship to follow with great satisfaction.

Mrs. Teale, who presently welcomed me, is the wife of an official in the British colonial service. Let young women who contemplate a similar career take notice. Her children, now in university and high school, are in Sydney. During her married life she has spent twelve years with them away from her husband; and when with him she has been separated from them. The fullness of family life with both husband and children together has been possible only during his leaves of absence, often spent in travel or visiting. That is the sacrifice which thousands of British, men and women, make for the Empire. They render a great service to humanity. All honor to them.

Dr. and Mrs. Teale have won through to the years of companionship. She accompanies us on our geological expedition and I am learning the pleasure of sharing her stimulating interest in every incident of our journey.

Grantham, a young fellow geologist, also accompanies us. Being familiar with the internal organs of an automobile, he will come in handy in the wild where garages

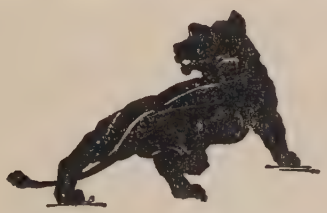
My Kodak Fascinates.

are lacking; but he also can contribute valuable observations to our discussion of rift problems.

At Dr. Teale's request Grantham has engaged for me a personal "boy" who is to be my shadow and my man-of-all-work. His name is Solomon or Suleiman. He is a Nyasa native, not over twenty, tall, powerful—a "good-looking darky," in the language of our southern states. Silent, respectful, keenly watchful of my every movement, he takes up his duties as my second self to do all those things I am accustomed to do for myself. I give no orders; I could not, for Solomon's English is weak and my Swahili weaker.

"He is well recommended," said Grantham, "but he has only recently come to Dar-es-Salaam where I got him, so he is not known. They say he drinks beer and fights." I looked at Solomon's muscles and concluded I would hesitate to pick a quarrel if I were a fellow black.

Occasion soon offered to show Solomon how to tie a bed roll so that it would not come undone if dropped in a river, yet could be untied in a couple of jerks. I did not explain; I simply did it. Solomon watched my hands, I his face. He was puzzled. I did it again. His look cleared and he now does it like an old professional.



II

Northward on the Trail of the Prince

We are tenting at Babati in "David's camp." This is the ground the Prince trod, here he sat within this ceremonial mud hut, and breakfasted where we are about to do the same. It would be most interesting if one could have shared his thoughts as he looked at the dark faces about him and over this beautiful landscape.

A few days before coming here he had met the native chiefs in a ceremonial gathering. Upon their reaction to the Government's policy depended the future development of their people, but the formulation of the policy was Britain's responsibility under the Mandate. Did he feel that he had a part in that or was his mind on the lion he had come to shoot? Both, no doubt, but in what proportion? Which really claimed his interest? They tell me he was not keen on sport until he had killed his lion.

Governor Cameron stands for the policy of restoration of native government among the blacks under carefully guarded direction by the whites. Disrupted by inter-tribal wars and German military domination, the tribes of Tanganyika might be in danger of passing into the state of legal servitude which is the lot of the Kafirs in

South Africa and of the natives of Kenya. But the British authorities strive steadfastly to meet the obligations laid upon them by the League of Nations. Difficult as it is to reorganize the natives under their own chiefs and to govern through the latter, that is the method which is bringing progress and prosperity to the negroes of Uganda and to the populations of the West Coast, and from it there will be no turning back while Governor Cameron is at the helm. He has had his disappointments, of course, as when the chief who had been presented to the Prince of Wales as the most progressive and promising pupil absorbed many thousands of tax moneys. It may be difficult for the untutored black to choose wisely between the examples set him by whites of all degrees, but the persistent British purpose does not waver because individuals fail.

We have driven north from Dodoma and our fourth day out brought us to Babati. Our procession when together comprises a two-ton Albion truck and a one-horse motor car misnamed "Trojan." It is an English attempt to produce a Ford and it makes you proud of Lizzie by contrast. Dr. Teale, Mrs. Teale, and I travel in the Trojan, with bags, lunch, and guns.

The Albion weighs two tons, carries two tons of outfit and fifteen hundredweight of "boys." On hills the boys get off and push. On bridges the load also comes off and the empty truck crawls cautiously over. Bridges are built by natives "to order." The D. O. (District Officer)

orders; the chief obeys. But who knows what rotten sticks go into the structure of poles resting on forks. It is thickly covered with brush and mud or grass matting. "Are there any bridges?" is a question anxiously put when inquiring about the road.

We started out from Dodoma with Mrs. Teale driving and Dr. Teale beside her, as she has not yet gained experience with the Trojan. So far as landscape goes Dodoma might be situated in west Texas. Thorn bush and dried grass border the road, which is a wheel track on a level plain. It was very refreshing, after four hours of monotonous glare, to run into a valley in wooded hills, the trees of unfamiliar species looking like the post oak woods of Arkansas. We lunched there and drove on, crossing the hills and traversing wide, flat plains all the afternoon. North of the Karema river, a dry "sand river," we began to climb, to the Trojan's distress, and ascended to the upland of Kondoa-Irangi. The evening came on delightfully cool and the air became chilly enough for a light sweater, almost as soon as the sun went down.

Kondoa-Irangi is a center of scientific research. Swinnerton, a naturalist who was a friend of Akeley, is located there in charge of the tsetse-fly research. The cattle scourge has depopulated large areas and threatens the whole territory. It must be checked and if possible exterminated. Swinnerton has eight men, botanists, zoologists, entomologists, and ecologists, at work on the

problem. He has been promised five years' support with a possibility of another five more, and is attacking the fly from every angle. The problem is exceedingly complex. After all the others had gone to bed he and I paced the moonlit hills till midnight, discussing the questions of forestry, grazing, and peoples, that are involved in the extermination of the fly. It is a very vital question for all East Africa.

It appears that the fly does not inhabit clearings, and, its range of flight being short, one can camp safely within a cleared space in a fly-infested area. Some impractical minds have proposed to clear all Africa, but Swinnerton regards the measure as one to be applied only in limited areas to restrict migration of the fly. The tsetse also avoids very dense thickets through which game does not pass. Botanists, therefore, have been set the problem of thickening up the African bush to produce barriers. It is possible that the infected tsetse which destroys cattle may depend on certain kinds of antelope or other animals. Zoologists are studying its associations in that direction. The tsetse which carries the germ of sleeping sickness may become harmless in course of generations of uninfected flies, and, since the infection can be acquired only by biting a sick man, the disease may be stamped out by preventing that biting. Hence the depopulation of sleeping-sickness areas "by order" and the quarantine of such areas against anyone who has sleeping sickness. In the course of years the area may be opened again. The

automobile is the worst offender in spreading the fly. Caught in the hood or on any other part, they are swiftly carried to new breeding grounds. They are spreading. Who will win, man's intelligence or the tsetse?

From Kondoa-Irangi we drove next day down into the Masai steppe, a vast dead-level plain which stretches away a hundred and fifty miles with scarcely a hill to break its monotony. It was formerly a fertile land occupied by an agricultural people, who sank deep wells and had permanent villages. The Masai, warlike, nomadic cattle raisers, drove out or killed that people and took possession. The abandoned fields grew up in scrub, the kind of sparse tree growth like mesquite which is the favorite habitat of the tsetse, and the fly is now spreading into the steppe, threatening the herds with that extermination which the Masai meted out to the former inhabitants.

Our road hugged the western edge of the plain, skirting wooded hills. We hoped to reach Galapo Mission on the lower slope of the volcano Ufiome, but a bridge over a stream one could jump forced us to unload the truck just before sundown, and we camped there near the native village of Kikore.

One of Swinnerton's assistants, a young zoologist named Nash, is established there to study the relations of the fly to the different game animals that roam the plains. We strolled up to his bungalow and had drinks on the veranda. He entertained us with his enthusiasm for hunting and his stories of game. An enraged python

had chased him a mile—and it was not a bootleg story either. The various types of antlers that hung over our heads were all choice specimens, very beautiful and most interesting. A pair of straight oryx horns, twenty-nine and a half inches long, is very near the record, the longest ever taken being thirty-one inches. Nash's rhino herd is sadly reduced. He had eight ponderous pets in his field of work, but six of them have fallen to one hunter or another.

Driving on next morning to Galapo Mission we caught sight of a herd of bright brown elk, I would have said at home—koodoo, they say here. It was the first game I have seen, but is not likely to be the last.

It being Sunday, the one Father at the mission was holding service with his dusky congregation; but they soon appeared, trooping out like other churchgoers, the few men walking with dignity, the women and girls chattering together. The dress is a piece of cloth like a sheet, worn in various ways, draped over the shoulders or head or drawn tightly around under the arms or tucked into a girdle. It may be white or plain tan or bright colored. These are native Africans, not Europeanized.

There is a little war cemetery at Galapo, in which lie twenty-nine English and one German soldier. Among the graves is one of a member of the family Rex, the last of his branch. It sprang from a morganatic union of one of the Georges and ended here.

The Father, an Alsatian, invited us to take coffee and discussed his garden, his plantation of six thousand coffee trees, and his crop of converts, all much in one tone. The site is a beautiful one: a gentle slope of very fertile soil, watered by perennial clear streams from the wooded heights of Ufiome, and commanding a superb view across the Masai steppe to Kilima Njaro, a hundred and fifty miles away. That nineteen thousand foot peak did not uncover its snowy head for us, though we looked often in its direction.

Bidding adieu in several languages to the simple hospitable peasant Father, we came west over a pass south of Ufiome to Babati. We reached here about two p. m. and decided to drive some twenty-odd miles north to see the great cliff that skirts Lake Manyara and extends far to the southwest—a strongly marked rift.

An hour, a precious hour, passed in instructing the boys regarding details of our camp, and we then set off in the Trojan, whose best speed is twenty miles an hour. Twelve or fifteen is our average and ten is a safe estimate on these tracks through the grass, where stream beds are stretches of sand. There the thin hard tires cut in deeply and all hands except the driver push.

Our objective was an isolated hill of gneissic boulders a couple of hundred feet high. We left the Trojan by the roadside, putting coats out of sight but otherwise leaving things to the honesty or fear of the natives, whose simple needs do not extend to the many claptraps of the *bwana*.

The view from the hill was very fine. The Manyara cliff, the Marienwand of German maps, in places is almost as bold as a Yosemite wall, reaches three thousand feet in height, and extends far to the north as well as to the southwest. Looking up it one feels dropped down, and the rift theory of a subsided lowland is a logical subjective impression. This is the southern end of the Eastern rift valley, the great rift which I expect to see later farther north in Kenya.

The view invited study and we stayed as long as we could. Then we hastened back, down between the big boulders, through tall grass, past native villages, and across the cornfields to the Trojan.

Sunset and the quickly ensuing darkness overtook us some miles from Babati, and it then appeared that the lights were out of order. We drove as long as it was possible to see the track at all. We had scooped up in the top of the car a goodly number of tsetse flies and they were out for an evening of it. Well brought up tsetses go to bed at dark, but these broke all curfew rules. They were as vicious as bees. Mrs. Teale, sitting beside the Doctor, battled them off him, and I kept them off her and myself, but only by continuous fighting. There is little chance in this region of their carrying the microbe that attacks man, but they can bite.

Dr. Teale finally ran off the road on a steep rise and the Trojan stalled in pitch darkness under dense trees. I got out to prospect and, walking ahead, heard voices. So I

shouted, calling, "*Njo-o! Lété taa!*" which in Swahili means "Come. Bring light!" and presently twenty natives appeared with two good American lanterns. Dr. Teale directed them to run before the car and we proceeded some two miles to Babati. It was a funny sight. I stood on the running board and had a full view of the excited natives running beside the car or hanging on it, while two pairs of black legs with invisible bodies trotted steadily in front.

Three more days of study in the southern end of the Eastern rift valley followed. We drove west to the foot of the Marienwand, the face of the central plateau, and saw the curious explosion craters west of Babati. They are like huge mine craters, more or less complete circular holes in the ground with vertical walls, but not a trace of lava. Nevertheless, they and the long extinct volcano, Hanyang, raise the question of the relation of the rift valley to eruptive agencies.

After once more enjoying Swinnerton's hospitable welcome at Kondoa-Irangi we have driven back to Dodoma. Tomorrow we start southward, bound for the extreme southern end of the Territory and Lake Tanganyika.

In the plateaus south of Dodoma lies the Ruaha rift valley, a little known depression, which is an important link in the supposedly continuous system that Suess traced from the Red Sea to Lake Nyasa. North of Dodoma

we have crossed a plateau a hundred and fifty miles wide without a rift. Such a gap, supplemented by another stretch of some eighty miles south of here, seems to me to break the continuity of structures rather seriously.

III

Southward on the Cape-to-Cairo Road

AGAIN the Trojan and the Albion with Dr. and Mrs. Teale, Grantham and myself, accompanied by Solomon and various other boys, are en route. We are winding southward from Dodoma over the arid plateau, across the deep valley of the Great Ruaha, and up on to the Iringa highlands. The road we are following is part of the Cape-to-Cairo highway. It may some day be followed by a railroad, branching from the trunk line at Dodoma, but hardly with Gilman's approval, since such a line would involve heavy grades to climb to Iringa and to get out of the Pocket.

Iringa is one of the plateaus suitable for white settlement, as the climate is salubrious and it also happens that considerable areas have been depopulated. These are open to whites under conditions consistent with the provisions of the mandate as interpreted for the British Government by the Governor of the Territory. There are also districts in which the natives are growing economic crops which, when sold in the world market, produce revenue. Transportation is thus a growing need, but Gilman would build more highways and a less difficult railway.

Some three hours south of Dodoma, after passing through a group of hills whose flat tops represent an older plain than that upon which we stand, we came to a sudden drop.

"This," said Teale, "is the Fufu scarp. It bounds the Ruaha rift valley along its northwestern side."

The escarpment is a well-defined cliff, something over a hundred feet in height where we struck it and higher toward the southwest; that is, to our right. The flat plateau that extends to its upper edge resembles the flat valley floor at its foot. Residual hills similar to those we have passed through stand in the valley. There is no doubt that the plateau and the valley floor were once continuous, each with the other at the same elevation. The continuous plain has been cut across by a fracture, and the parts are displaced with reference to one another. The cliff represents a fault or rift.

What, however, was the original elevation? In this particular case was it the present level of the plateau or of the valley floor? Has the valley sunk or has the plateau been elevated? The answer one way or another bears upon the origin of rift valleys, that is, of valleys formed by dislocations of the earth's crust rather than by the work of running waters.

Long-established habits of observation lead me to look to the hills and valleys for a solution of problems such as this. In every region there is an older landscape, the predecessor of the actual one. The change from one

to the other has been caused by movements in the earth's crust. In course of the movements the features of the landscape, the plains, hills, and valleys, have been elevated or depressed, warped or tilted into positions in which they could not have been formed, and are now being modified by the agents of erosion, especially by rivulets and rivers. Features that are thus brought into an untenable position, one in which they must be changed or destroyed, are out of sympathy with their environment.

Thus, to solve a problem of a modified landscape seek the features that are out of sympathy with their actual environment and restore the environment in which they belonged.

Standing on a commanding point of the Fufu escarpment and looking to my left, I saw the valley end in a group of hills toward which the floor rises by a gradual slope. The cliff dies out and passes into a flexure of the old surface. Traversing the hills is a river valley, but no river. Yet a river of large volume, though gentle current, once flowed there. Were it now flowing there it would run with a strong current toward me down the flexure into the valley at my feet. If the valley floor were raised to the level of the plateau the old grade of the river would be restored and the stream might flow either way. It was a very low grade, possibly near sea level.

In my mind's eye I see a quiet stream pursuing its winding course through the rich verdure of a coastal plain. It is shaded by broad-leaved trees and palms. The

languorous heat of tropical lowlands replaces the dry atmosphere of the arid steppe behind me. I have turned back the pages of continental history to a time before the extensive lowland plain was pushed up from its original position to that of the plateau.

This view of the past suggests an explanation of the process of change by which the valley at my feet has been formed. If it be agreed that the plain has become a plateau in consequence of elevation above sea level, then it may follow that during the progress of elevation a fracture occurred and one side, which is now the valley floor, ceased to rise, while the other side, which is now the plateau, was pushed up higher. This rift valley appears to be simply the effect of unequal elevation.

But there are other possibilities.

The advocate of an alternative explanation maintains that the surface was elevated in the form of an arch and when it had reached its highest curvature was stretched by tension. The stretching caused a block to drop in, like a keystone, and the rift valley corresponds with the dropped block.

This is not a case of tweedle-dee and tweedle-dum. It involves the action of stupendous forces acting upon the earth's crust, the direction of the forces, and the manner of their action. The mechanics of the operation of moving a large part of a continent present problems on a scale beyond our usual experience. They are the very problems I have come to Africa to study, and the rift valleys may,

I hope, throw light upon the subterranean activities to which they are due.

The Fufu scarp and the Great Ruaha valley which it defines are my first rift valley. How was it formed? My old friend Suess, the great Austrian geologist, held that no large part of the earth's crust could be raised vertically, directly against gravity, because, according to his understanding, there is no force stronger than gravity. It was his view that all differences of level of wide extent have been caused by subsidence. The ocean basins have deepened, the waters have been drawn down to lower levels along the coasts of continents, and portions of the lands have also sunk. If he was right in this inference, then the idea that the rift valley is an effect of unequal elevation must yield to the alternative view that it is a result of unequal subsidence, always provided that we limit the explanation to the action of vertical forces.

In considering hypotheses, however, we need not limit speculation by any such arbitrary condition. It is well known that the Alps and many other great mountain ranges have been raised by a process of folding or crumpling up because the mass was subjected to irresistible horizontal pressure. Compressed as between the jaws of a vise, the mass was pushed up. Suess recognized this fact and he proposed the theory that the rift valleys represent fallen arches: first a great arch, then the pulling apart of the buttresses that sustained its thrust, and consequently the dropping of the keystone.

The simple features of the Fufu scarp do not offer any evidence by which to knock out either one of these three possible explanations of the Ruaha rift valley. The long narrow block beneath the valley may have lagged behind during a general elevation, or it may have sunk deeper than adjacent masses during a general subsidence, or it may be a dropped keystone. We have just begun to examine the evidence and it is too soon to look for conclusions, but I find this first glimpse suggestive and stimulating.

We have driven on to camp on the Great Ruaha river, which we crossed on a ferry. In a scanty grove the tents are raised and the porters, a distinct group who do the heavy work, bring loads of bedding and provisions from the truck. Solomon, my husky boy, like other aristocrats, does no portering. If I want a box I call him and say, "*Lete moja*, or *mbili*, or *tatu*" (bring number one, two, or three) and he calls a porter whom he accompanies to bring it. The long-established classes of African, as of English, society are deeply rooted. They cannot be changed.

Grantham picks up the rifle and shotgun and says he will see if anything can be had for the larder. He accepts my offer as gun bearer and I do my best to take the weapon as though I were an old hunter. In two hundred yards we run into a flock of guinea fowl, of which Grantham eventually gets three; but of impala, the nearest thing to our deer this country affords, we see only numerous tracks.

Dinner is in preparation. The tents have been up an hour and I have bathed, as is the custom. The African habit on making camp is first tea, then bath, and then dinner about eight o'clock.

Our next camp is a few miles southwest of Iringa, the former capital of a native chief and now the district headquarters. We have climbed to an elevation of fifty-five hundred feet in a wide valley among high hills, a very beautiful, well watered, and well wooded country. A good graded road, almost a highway, connects it with Dodoma and extends southward. Neat brick houses and tiled roofs give the town a very attractive appearance. It will always be an important point on the Cape-to-Cairo road. The district having long been occupied by natives, it cannot be alienated to white settlers, but both English and Germans are settling some thirty miles farther south in a depopulated region.

On leaving camp on the Great Ruaha this morning there was a chance of getting an impala, so Grantham came along with his rifle. We flushed a flock of twenty guinea fowl; saw a big gray monkey lope across the road, though evidently anxious for her little boy who scampered about like other youngsters; and started a couple of dik-diks, the tiny antelope, into vertical jumps before they sprang away. They seemed to released steel springs under themselves to get to their feet. They ran into the bush, but stood to look back not a hundred feet from the road.

Then Dr. Teale suddenly jammed on his brakes. Just around a slight turn, only partly hidden by a scrubby tree, stood three great giraffes. They looked down on the Trojan with curiosity but did not run. Mrs. Teale wanted a photograph and both she and I had to move to get it. We moved stealthily, but they were off. You know what a giraffe looks like in the zoo, but the sight of that splendid creature, standing broadside on, beautifully marked, his nose quivering as he scanned us from his height, was something different. It set my pulses beating. Fortunately the law protects them and they will survive. They went only a little way and stopped to watch us, though not for long.

IV

The Pocket of Tanganyika Territory

WHERE we crossed the Great Ruaha yesterday it was flowing northeast, toward the upper right on the map. There is now no outlet to the sea in that direction and the Ruaha seems to be running upstream. It does not go far, however, before it turns off to the right and flows southeast to the Indian Ocean. In doing so it has to cross the Iringa highlands.

It is not unusual for a river to leave a broad valley and plunge into a narrow canyon, apparently against all reason, but when it does so it is always because at some previous stage of its existence the route over the canyon was the natural one for it to take. The previous stage in the case of the Ruaha was before the elevation of the Iringa highlands and the breaking at the Fufu scarp, when the landscape was that of an extensive plain across which streams meandered quietly. I think the Ruaha then flowed out northeast by the old channel that winds through the hills that were on my left when I stood on the cliff. In consequence of the gradual movements of the earth which depressed the rift valley and raised the plateau, relatively to one another, the stream was tilted backward and its flow was checked. It may have been

ponded, converted into a lake. It is said there are lake deposits in the valley.

The landscape at that time was quite unlike the present, and yet the features we now see were outlined. Then as now the Great Ruaha gathered its waters from the west and southwest. The cliffs that define the rift valley had begun to appear, trending northeast. The Iringa highland had also begun to develop. The warping barred the ancient course of the river, whose waters gathered in the depression. Before the Iringa highlands gained any considerable altitude the basin filled and overflowed at the lowest pass, which happened to lead southeastward on the shortest route to the ocean. The Ruaha, once established in this course, maintained it by cutting down its channel as the highlands continued to rise to greater altitudes above sea level.

This seems a probable explanation of the Ruaha's present course. Another is that the river, though perhaps not ponded by the warping, was so reduced in its grade that it loitered through tropical swamps on its relatively long path to the sea. A more vigorous stream, running down the southeastern slope of the Iringa highlands, cut back through them, reached the loiterer, and carried its waters off more directly to the ocean. Streams are constantly fighting each other, and captures of this kind are not uncommon.

Captures are, however, not easy when the divide between watersheds is high. They occur more frequently

in low countries and therefore more frequently in the earlier stages of warping. The same is true of the overflow of a ponded river into a new channel. There is every reason to think that the Ruaha assumed its course across the Iringa highlands when they were comparatively low, and that it held on its way as the relative height of the upland increased.

Now did these interesting changes of the river's course occur because all the region was being pushed up, the strip of the rift valley meanwhile not rising quite so much as the plateau and the Iringa highlands? Or did they follow upon subsidence of the ocean level and relatively slight subsidence of the valley floor?

So far as I can see, the effect upon the river would be the same, whether the land surface rose or the sea level sank. The fall of the stream depends simply upon local relative altitudes, and the Great Ruaha does not decide the alternative, as I hoped it would. The aberrant course across the Iringa highlands was evident upon inspection of the map. I noted it long before I landed in Africa and I have looked for a decisive group of facts bearing upon alternative hypotheses, but the Ruaha does not furnish them. It remains neutral.

Nevertheless, there is one conclusion to draw from the history of the Ruaha, which limits speculation. Sudden changes of levels of sufficient extent to influence the flow of the river are excluded from a place among reasonable hypotheses by the persistence of the course

across the highlands. The rise could not have been more rapid than the erosion of the river bed, or the stream must have ceased to flow in that transmountain channel. This bears adversely upon the idea of the elevation of an arch and the dropping in of a keystone. Let us consider alternatives.

If any land surface be uparched the rivers flowing down the slopes must be quickened and will erode canyons. Such rivers will grow at the expense of others less favorably situated, and a lateral or radial system of drainage lines will be established, running down the steepened slopes of the arch or dome.

If the arching is rapid and the dropping of the keystone follows shortly, the canyons may be only slightly developed and the adjustments of the streams to the new grades may remain imperfect. On the other hand, if the arching is slow, the development of radial canyons should be proportionately considerable and the adjustment complete.

In the case of the Great Ruaha the dropped keystone should correspond with the rift valley that extends from southwest to northeast. The lateral streams should diverge toward the northwest and southeast. Since the changes of level developed gradually, the canyons should be at least as pronounced as the gorge of the Ruaha across the Iringa highlands. But there are no such canyons. Rivers rise in the plateau northwest of the rift valley, flow toward it, cross it, and leave it. There is no sugges-

tion of the drainage system required by the conditions of gradual uparching.

Rivers are the oldest and most sensitive indices of changes of level. It seems impossible that the Great Ruaha could have taken the course it pursues if an arch had ever developed over the rift valley into which it flows, between the Fufu scarp and the Iringa highlands. For this case, at least, the hypothesis of uparching, stretching, and failure, accompanied by dropping of the keystone, cannot be entertained.

In leaving the broad Iringa plateau, where the Great Ruaha heads among granite hills that stand above the flat lands, we have descended long gradual slopes, warped surfaces of the ancient plain. We have come down to the relatively low valley of the Songwe, an unfortunate river that runs northwest. In that direction lies no possible outlet to the sea. The salt pans of the Rukwa rift valley receive the waters, and the thirsty air drinks avidly from the white soil across which heat waves vibrate. High cliffs wall the Pocket of Tanganyika.

On either side of the approach from the east stand conspicuous mountains. To the south is Rungwe, a volcanic pile which fills the space at the head of Lake Nyasa between the Livingstone mountains and the plateau of Rhodesia. Had not the subterranean fires blocked the way by eruptions from many vents, there would be an open pass southward to the lake in lieu of the diffi-

cult divide, which is one of the obstacles to be avoided by Engineer Gilman's railway system, though it is crossed by a motor road.

Rungwe is not now an active volcanic center, but it is one of peculiar interest because of its location. It occupies a central point at which the rift valleys form a Y. Where the northeastern branch or Ruaha rift meets the northwestern branch or Rukwa rift, and where they both join the stem or Lake Nyasa rift, there is Rungwe piled up. It is always an interesting and to a great extent unanswered enigma, what forces molten rock from within the earth. That was a problem even when we thought we lived on a crust over a molten interior, and now that we know the solid crust to be two thousand miles thick there is the additional problem of the melting. Here is Rungwe, a considerable mass to our eyes, squeezed molten from within the solid globe. What does it represent? How large a melted body, why melted, and how extruded? Standing as it does at the junction of divergent rift valleys, the volcano takes a significant place in the general question of their origin. But what is its significance? The mystery deepens.

To the north of our approach is Mt. Mbeya, a most singular angular peak which attains an altitude of ten thousand feet above sea level, some five thousand feet above the plateau north of it, and seven thousand above the Songwe valley south of it. It is not volcanic. Teale and Gilman, who have climbed it, both say it consists

of crystalline schists of ancient date. These are soft rocks, not such as would maintain a residual hill above the old plain of the plateau. The lack of resistant hardness, as well as the great height of the mountain, rules out that explanation. Rather does it look as if the corner embraced between the two branches of the Y, between the Ruaha and Rukwa rifts, had been turned up by some peculiar action.

With eager interest I study the outlines of Mt. Mbeya, but can find no clue to an explanation of the height. We cannot stop to climb it for there is a fortnightly steamer to be met on Lake Tanganyika. And for the same reason I have to be content with a distant glimpse of the pocket valley, the Rukwa rift, feeling that I may be missing big geological game as well as the lions and rhinos said to abound on the heated plain.

We are about sixty miles north of the head of Lake Nyasa, two days' travel since I last wrote, and are leaving Tukuyo or Neu Langenburg, a certain center of importance, behind us as we turn westward toward Abercorn.

We are still driving on the Cape-to-Cairo road. Across Tanganyika Territory it is an excellent improved track, not a completed road since foundations are lacking. For the first few miles south of Dodoma it is a railway grade which once sprang from the ambitions of the would-be capital and ended in the arid steppe. Where engineering has been necessary, as down the Fufu scarp and up the

On the Cape-to-Cairo Road. Not Used During the Dry Season Lest It Wear Out.

long slope between the Ruaha valley and Iringa, a good grade has been blasted out. Elsewhere it shows European influence chiefly in the surveyor's line which, being straight, differs from the natural winding path of game and hunter. The bush is cleared, the surface scraped. Even a Trojan can roll over it at fifteen miles an hour or possibly twenty.

Yesterday our solitary journey was interrupted. We had pulled out to pass a travel-stained Ford of the new model, when the driver waved frantically and Dr. Teale shouted "It's Stockley." Stockley is one of his geologists who has been on leave and is on his way back to Dodoma. He had come through from Capetown, having driven seven thousand miles to and fro from one interest to another, accompanied by Mrs. Stockley, a jolly boy of five, a mastiff pup, and a cat. I gathered that a monkey had once been part of the happy family but had made good his declaration of independence. Stockley has been on the road for three months, doing his own camp work with Mrs. Stockley's assistance. Though travel-worn they were happy, and he was ready for immediate field work; but Mrs. Stockley thought she would stay in Dodoma awhile. I may have a trip with him later on, if I succeed in my purpose of coming back this way to see the Livingstone mountains, ten thousand feet high, and the great rift valley of Lake Nyasa.

Inquiries about the road ahead of us elicit the fact that it has not yet been cleared since the last wet season,

now several weeks past. The grass stands high above the radiator, effectually hiding all obstructions or holes in the wheel tracks. It is generally withered. "Where it is green," said Stockley, "there's a bridge and you'd better examine." We have some two hundred miles to go on our westward route to reach Mpulungo, the port at the southern end of Lake Tanganyika where we will take the steamer for ports along the east coast as far as Kigoma.

The days have had their incidents or accidents: a rotten bridge to repair, a radiator pipe to mend, a number of hills where we got out and pushed the Trojan up; but those things are routine by this time. Every one takes them happily. I do not remember having camped with a group that took to camp life more cheerfully. They are so considerate of me that I have to be very careful. They take my banter about English ways in the kindliest spirit. The "sacred rite of O Tea," as I have called it, has especially excited my mirth. To hold up a lorry at five in the afternoon, unpack it to get out the kettle, cups, tea, biscuit, butter, and jam, and to sit down by the road for three quarters of an hour when one should be getting into camp, are more than I can resist. But they laugh with me and take no offense. I come in for my share and seem to give them considerable amusement.

Turning southward we make the long ascent from the Songwe valley to the plateau of Rhodesia. The Trojan carries Dr. Teale and tries to climb. Mrs. Teale and I

not only climb but push, and pushing beside that willing lady I share to some degree her gentle pity for the Trojan, poor thing, a two-cylinder motor cycle with an overgrown body, quite fit for service on English roads but sadly overtaxed on an African track.

The pace is leisurely and from time to time the Trojan stops to fan itself. There is time to observe. The rock of the escarpment exposed in the road cut is not what it used to be. It is altered, cemented by a deposit of silica, that hard, resistant quartz which dissolves at high temperature and great pressure. It has been left here by solutions rising from below. This is the face of the fracture or fault that corresponds to the southwestern cliff of the Rukwa rift valley. The conditions of temperature and pressure requisite to dissolve so much silica are not consistent with the relaxation of pressure, the tension assumed by Gregory's rift theory. The cemented, silicified rock, which is intimately crushed, bears witness rather to intense compression.

We climb to the broad divide along which the boundary was established between German East Africa and Northern Rhodesia, between the empire of the Kaiser and the imperial claims of Cecil Rhodes. It is still the boundary separating Rhodesia and the mandate Territory of Tanganyika, between British colonial aspirations on the south and British responsibility to the League of Nations on the north. In both the blacks patiently await their future, but in Tanganyika the policy of

reestablishing native self-government under British direction should eventually develop self-respect and a sense of responsibility. In Rhodesia the coming exploitation of great copper mines and the self-interest of white farmers tend toward tribal disintegration and servitude. Two opposed tendencies of racial conflict appear on our right hand and our left, as we drive westward along the boundary.

Here is the African phase of the World problem, the future of the races. Great Britain's policy was laid down in 1923 in stating the principles that should direct the policy of administration in Kenya:

"Primarily, Kenya is an African territory and His Majesty's Government think it necessary definitely to record their considered opinion that the interests of the African natives must be paramount, and that if, and when, those interests and the interests of the immigrant races should conflict, the former should prevail."

This is also the guiding principle of the committee on Mandate Territories of the League of Nations, and yet—what will be its value to protect the native when his labor is required, as it soon will be, to mine the billions of tons of copper in Rhodesia for the world's use? Who will protect African villages, African homes from depletion of their man power?

The Negro already foresees the answer. A folk tale from the Congo runs in this wise:

The Great Spirit brought his children to the river and told them to go up or down. They took canoes and some paddled up the river, while others floated down with the current. Those who went up came back white and to them the Great Spirit gave all good things. But those who had gone down the river were black and to them the Great Spirit said: "You shall have only to eat and drink and you shall work for the whites, always."

The evidence of German occupation is still to be seen in the behavior of the natives. They have been dominated. As the car approaches they stand aside; they put loads on the ground or lean a spear against a bush; they hold up one or both hands, palms out; some of them click their bare heels together and give the military salute. What is more obviously an old native custom is squatting and clapping the hands together, perhaps calling out a greeting. They are very friendly and also more completely native than I had expected. Houses, clothing, food, and customs are but little changed. The mirror on the side of the car is a source of wonder, delight, and merriment. It was most amusing to see a withered old hag push a bevy of tattooed beauties aside and then gleefully admire her wrinkled old self from every possible angle.

TANGANYIKA TERRITORY

The map represents the central part of Tanganyika Territory, formerly German East Africa. An angle of the high plateau that stretches south from Lake Victoria is bounded by two rift valleys, the Great Ruaha valley on the southeast and the Rukwa valley on the southwest. The Iringa highland and the plateau of Rhodesia lie to the southeast and southwest of these valleys, respectively, shutting them in. Lake Nyasa extends south. It is but 1500 feet above sea. Adjacent heights rise to 10,000 feet. The southern end of Lake Tanganyika breaks into the plateau of Rhodesia in the west, lying roughly parallel to but not connected with the Rukwa valley.

The Tanganyika plateau is high but very flat. From its grassy plain rise peculiarly bold, isolated hills, sometimes a thousand feet or more in height. They are called island mounts. Survivors of some process of sculpture which they have resisted while the plateau was being planed, they puzzle geologists, who are not agreed as to the peculiar conditions that have governed the action of wind and water in working out the landscape. The author reasons that the surface formerly stood at a much lower altitude, close to sea level, and that it has been elevated. The rift valleys are interpreted as sections which have lagged behind during the progress of elevation.

Sketch map drawn from the Zanzibar sheet of the Two Millionth Map of Africa.

TANGANYIKA PLATEAU
3000 to 5000
RHODESIA
Lake Tanganyika
2550'
Rukwa Rift Valley
2000'
Mbeya
9000'
Rungwe Volcano
10000'
Livingstone Mts
Wyasa
Mpulungu
Abercorn
Kalambo Falls
Lupa R.
Kiejo L.
Kyela
Iringa
Dodoma
Ruaha R.
Great Ruaha R.
Usangu Plains
Usangu Basin
Mbeya Range
Kipengere Range
Poroto Mts
Kitulo Plateau
Uporoto Mts
Kilombero R.
Mufindi
Njombe
Makambako
Mbeya
Tukuyu
Kyela
Iringa
Dodoma
0
50
100 Miles

V

Lake Tanganyika

Across the hollow from our camp in the field are the fire lights of Abercorn, the first residency at which we can report our arrival in Rhodesia. Do not imagine that one is free to cross boundaries unchecked in Africa as from state to state in America. Regulations regarding game and the migration of natives demand that one report to a district commissioner. Yonder fires are in the police lines, native police under British command. We arrived too late to report tonight and are camped outside till morning.

We are waiting for dinner. Having driven one hundred and six miles today in eleven hours, a record for the Trojan and lorry, we did not make camp until seven o'clock; so the cook is doing well to have the leg of goat roasted. To be sure it was boiled last evening in order to keep it. Here is the goat.

Having partaken of the goat, Grantham and I were sitting in the dark outside our tent when he exclaimed sharply, "Look at that!" His face was lighted up brilliantly. Turning, I saw a superb meteor coming appar-

ently from the southwest. It looked as large as a dinner plate and behind it was a faint glow, a trail of light. It may have been a white light or warmer; I was too astonished to note the color carefully. In a space too brief to estimate, it vanished. I had risen to my feet and taken a few steps to call Dr. Teale, who had been under cover in the lorry and had not seen it, when we were startled by a loud report. The falling star had burst and the earth had taken to herself another of those relatively infinitesimal but innumerable meteors whose assembling has been her growth.

A hundred miles or more up Lake Tanganyika at that instant an engineer and his wife, sleeping on the beach, were awakened by the light and seemed to see the meteor disappear beyond the lake or plunge into it. Then they heard the report. "It sounded as if it hit the lake," he told us when we met.

Abercorn, still a frontier residency, stands on the site selected by Sir Harry Johnston in 1889. At that time Johnston, who had been sent by Lord Salisbury to get ahead of the Portuguese in making treaties of friendship with native chiefs, had pushed up Lake Nyasa, into the Rukwa valley, and across the plateau to Lake Tanganyika. In his "Life" he writes:

> As we got to the northern edge of the plateau and could look down on the distant expanse of Tanganyika, I pitched on one spot—my camp for a day or so—which seemed singularly well suited for a future town, possibly the chief station of the Tanganyika district. I made a treaty with the Ulungu chief and purchased the site, on the

edge of a beautiful forest through which the road descended to the lake level. I called the future town "Abercorn," after the Chairman of the British South Africa Company.

Entering Abercorn in the morning, we passed the police lines, a group of a dozen conical mud huts evenly spaced in a well swept square, and drew up to the post office, a brick building presided over by an Indian functionary. Here was a telephone by which to speak to the port of Mpulungo on the lake. Dr. Teale was worried lest we get left. The steamer had arrived the day before, there was nothing to detain her, and she would have steamed away, except that her Arab captain had been informed we might be expected. We had fifteen miles to drive, down a steep and stony road from the cool plateau at four thousand feet elevation to the tropical heat at twenty-four hundred. The captain agreed to wait till early afternoon.

While Dr. Teale was worrying about his connections I looked eagerly for the first indications of the great rift valley that contains Lake Tanganyika. There was reason to expect something unusual. The lake basin exceeds all others in length. It is the second deepest lake in the world, being next to Lake Baikal in this respect. We approached it over a high plateau which reaches its greatest altitude in the vicinity of Abercorn. I was expecting to come abruptly to a high cliff from which the eye would sweep over the lake far below—such a view as one gets from the margin of the gulf that

holds the Dead Sea. But as is commonly the case, Nature offered variety.

Below Abercorn toward the west wooded slopes descend into a ravine. They are not too steep for a convenient road grade. They present neither the precipitous profile nor the straight alignment one would identify with a rift. On the contrary, they are slopes such as streams develop anywhere in similar rocks, gneisses, and quartzites. The only evidence of a change of levels is in the activity of the brook that, in the bottom of the ravine, goes cascading to the lake.

During the drive across the plateau I read the history of the landscape in the succession of hills, plains, and shallow valleys. It is a simple story, but it covers an enormous length of time—many, many millions of years.

As I see it, the continent has been lifted, though according to Suess we should say that sea level has been lowered. That alternative is a kind of Banquo's ghost at the feast of reason, but let him sit in the King's seat while we talk about the realities.

During the earlier ages which the landscape records, the continent was very stable. Its huge mass rested on firm foundations and its surface was planed to a smooth lowland. Lifted a few hundred feet, it again stood steady for a long time and was again smoothed off. Another lift occurred and gave the streams another chance to sculpture the land. They first cut ravines and then widened them to mature valleys between broad, low divides.

That is the landscape we passed yesterday in crossing the valley of the Momba river—a little stream in a valley much too big for it, like a little boy in his grandfather's Dutch breeches.

The disparity between the Momba and its wide valley led me to anticipate some evidence of its former greatness, and I was not surprised when we drove up a moderately steep grade between rocky walls, following up the abandoned gorge of a much larger stream than any we had seen. But the river that once rushed down it, carrying its larger volume to the Momba, no longer flows that way. It has been diverted to the deeper basin of Lake Tanganyika.

The history of the river sheds a flood of light upon the later movements of the land surface. When sculpturing its mature valley after the second slight elevation of the continent, the Momba headed in the hills southwest of the present site of the Tanganyika basin. That depression did not then exist and a large river may have flowed south over the plain to a junction with the Momba. We might call it the Tanganyika river, though we must think of it rather as a tradition than as a fact.

Beneath this quiet scene of gentle rivers and sylvan plains the unknown earth forces gathered slowly for a greater effort than the previous uplifts of the continent had demonstrated. They raised and warped the land. On a slope that developed between the high plateau where Abercorn is located and the lower Momba,

the river flowed swiftly and cut out the gorge our road followed. But while it was thus engaged the Tanganyika valley sank much deeper and the stream, turning into that great depression, helped to make the lake. It now cascades gayly down the ravine below Abercorn, the gorge in the old course is abandoned, and the beheaded Momba runs feebly in its wide valley. It flows to the Rukwa rift valley, to enter which it leaps in a high fall, the symbol of youth. The Rukwa and the Tanganyika are similarly young depressions.

According to this story, as told by the rivers, the region around the south end of Lake Tanganyika was a focus of vigorous uplifting forces, and yet the bottom of the lake basin must have actually sunk down, since it lies sixteen hundred feet below sea level. Here is something to think about.

Afloat on Tanganyika! We soon shall be—another cherished dream come true! The little *Mwanza*, a sixty-foot barge, is waiting for us, and we shall be off for Kigoma early this afternoon. Teale is happy. We have made the connection toward which in thought he began traveling anxiously while I was still delayed by adverse winds and currents off the East Coast of Africa.

Coming down the grade from Abercorn we have run beside the happy brook that dances to the lake. It is as young, no doubt, as it looks. Johnston records his delight in the scenery of precipitous mountains and

waterfalls, which he saw with the eye of the explorer and artist. After days and days of waterless steppes which he had crossed on foot, the flashing spray of the fall, the deep cool pool where the water eddies, reluctant to leave, must have been a joy indeed. The charm of wooded slopes, of bold profiles, and of the blue lake stretching beyond the horizon is irresistible. One would love to linger and sketch as he did, the while he spread the protecting mantle of Great Britain over the native tribes.

He gives a picture that is no longer to be seen. Describing a secluded bay of the southwestern shore that lies in the mists to our left, he writes:

The estuary of this Lofu River was of unruffled smoothness. Most waterbirds detest the rough, sealike waters of great lakes or the ribbed current of a rapid stream. If one turned one's gaze toward the open lake one saw only small gray gulls with black-barred faces and black-tipped wings, and large scissor-billed terns with crimson beaks flying with seeming aimlessness over the troubled waters. But in the estuary what an assemblage of bird forms! There were pelicans of gray, white, and salmon pink, with yellow pouches, riding the water like swans, replete with fish and idly floating. Egyptian geese, fawn-colored, white, and green-bronze; spur-winged geese, bronze-green, red-faced, white-shouldered, white-flecked; African teal colored much like those found in England; a small jet-black pochard with a black crest and yellow eyes; whistling tree-duck either chestnut and white or black and white, zebra-barred; huge *Sarcidiornis* ducks with knobbed beaks and spurred wings, and a beautiful plumage of white and bronzed-blue, with a green-blue speculum in the secondaries of the wings. All these ducks and geese hung about the fringe of the reeds and the papyrus. The ducks would be diving for fish, but the geese were more inclined to browse off the water-weed. Every now and

then a disturbance would occur; I might cough and they would be recalled to my presence; or one of Kabunda's children would come down to the bank and tell me a meal was ready. Then the ducks would scutter over the surface or the geese rise with a clamor for a circling flight.

Farthest away of all the bird-assemblages would be a long file of rosy flamingoes sifting the water for small fish and molluscs. They were so far off that their movements were scarcely perceptible; against the green background of the marsh they looked like a vast fringe of pale, pink flowers in full bloom.

The old hunting instinct and the shotgun have done their work. We see but few waterfowl in the sheltered bay at Mpulungo where we find the *Mwanza*—no more here in tropical Africa than one can see in the estuaries of the New England coast in autumn. One might easily imagine oneself there. The little bays on either side of the tiny peninsula might be picnic coves on the coast of Maine. The hills rise steeply from the lake, the foliage has our early autumn colors, the little pier might serve a summer hotel. Only the half-naked natives suggest Africa.

The *Mwanza*, like the ocean liners she otherwise does not resemble, has a bridge deck, and there we live, that is, the select few do. The decks otherwise are floored with humanity, negro and Indian, sleeping, eating, and enduring in huddled groups. One almost has to step on them to step anywhere.

A surprising individual is the negro migrating in search of work. Does that contradict your preconceived

notion? It does mine. Think of a Mississippi plantation darky setting out to find work in California or Chicago, walking several hundred miles carrying all his possessions on his head, traveling on steamer decks and platform cars as a no-class passenger, and eventually going back to his cabin—a man of the world. A fellow passenger who has lived among the African natives these six years and seems to know them well tells me the girls of a village say to the young sparks, "Don't you think it is time you went somewhere to know what's what?" And if a man who has not been away raises his voice in council he may be taunted with: "What do you know about the world? Listen to your betters."

At any rate here they are, a boatload of them, and the older ones are accompanied by wife and child. A group of four women and several babies sleep next to me on the upper deck beyond a slight iron rail. Any one of them might be a cook in Washington. Their men are grouped across the deck, voluntarily segregated; but when the sun blazes down they huddle in the shade of a blanket tied up with a piece of string the gift of which has won me their good graces. These migrations are made semi-annually by thousands. They constitute part of the African problem: instructive, helpful in some aspects, in others breeding disease and immorality.

The obsequious, graceful, but anæmic East Indian is the parasitic trader whom no one trusts but every one needs. He has all the trade. He keeps all the shops in

Dodoma (they are simply oriental bazaars) and he drives the peddling throughout the native villages. I do not know how he reaches the ones that are beyond motor traffic, but where there is even an apology for a road he is to be met, riding in a motor lorry accompanied by his wife and servants, among whom is a negro chauffeur. He is enterprising, but he is too sleek. He is the only thing I have met that suggests slugs in the garden.

We are the privileged ones. Dr. and Mrs. Teale occupy the only cabin, which is also the dining room and social saloon. My camp bed is set up abaft the wheel and I have by all odds the best of it. All the airs that blow are mine and they are fresh off the lake, not scented with the perfumes of Africa, as they are below.

We have picked up three other first-class passengers, one of whom is Sœur Marie St. Jacques, Mother Superior of the Catholic missions throughout a large territory that comprises all the western half of Tanganyika and extends into Nyasaland.

Sœur Marie is from the Côte du Midi, which she left thirty-two years ago. She is now sixty-four, a typical French peasant even in her nun's dress. She is short and stout, but evidently strong, else she could not return in health and spirits from a two months' *safari* to the various missions. Much of it she has done on her own sturdy feet, some of it in a hammock with four bearers, but her chief support has been her courage and cheerfulness. She is a happy old woman, having by faith and force

of character won through to the satisfaction of achievement.

Last night she shared the bridge deck with the engineer and me. She sat all night in a lounging canvas chair and responded cheerily to my *bon jour* when I emerged from the concealment of my mosquito net. We have chatted from time to time, while my French lasted, and she has talked Swahili with the others. Mrs. Teale, who is not yet fluent in Swahili or French, tried to talk with her but was overwhelmed by the flow of language. Sœur Marie has enthusiasm and gives vent to it.

Our other two passengers are an engineer and his wife. Born in Rhodesia, he followed electrical engineering and soldiered in France. But he returned to the bush, where he prospected for land and minerals for six years alone. Having taken up twelve hundred acres of coffee land at an altitude of six thousand feet on the plateau east of Lake Tanganyika, he married. Now he is running a mica mine while the coffee trees grow to bearing. His wife is one of those astounding creatures called Woman, astounding for courage and devotion. Slight and worn by tropical pioneering, she has strength for whatever befalls and goes quietly but happily to live with him alone, the only whites among forty thousand blacks.

When I roused this morning, dawn was breaking, and against a golden sky streaked with rose I saw blue silhouettes of serrate, precipitous profiles rising right from

the lake. I sat up and rubbed my eyes. Then I grabbed my water colors to fix the fleeting vision. Perhaps it might be an illusion. We had seen nothing like it previously.

Perhaps you have been expecting some account of the wonderful cliffs that wall the chasm of Lake Tanganyika. I expected to see and describe them, for a *rift* valley lies between cliffs and the lake occupies a *rift*, according to all accounts. But accounts are not always accurate. If Lake Tanganyika lies in a rift valley then rift valleys are not always bounded by cliffs; or if rift valleys must be bounded by cliffs then the Tanganyika trough is not a rift valley.

The western shore of the Hudson from Hoboken to Newburgh is quite as bold as the shores of Lake Tanganyika. The bays and islets of the Maine coast are duplicated for miles along Tanganyika's margin. Technically speaking, the lake has a drowned coast. Only here and there is a steep straight facet or line of them that suggests faulting.

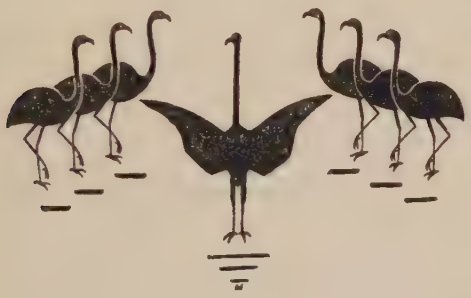
What then did I come to Africa for? Is there no "rift" problem? I have no anxieties on that score. There is a great big problem. But the superficial expression of it in cliffs, valleys, plateaus, and volcanoes is not so extraordinary as it has been imagined to be. It is rather comforting to find that I am confronted, not by a new problem, but only by a new phase of the old problem: Why isn't the earth a billiard ball?

But though the shore of Tanganyika from Mpulungo to Karema is picturesque rather than grand, the glimpse of Kungue at sunrise lends grandeur to the shifting scene. The mountain is the highest of a group of sharp peaks and spurs of almost alpine forms. Hard rock, vigorous uplift, intense erosion have combined to give strength to the sculpture, and tropic warmth and rains clothe the slopes with the verdure of bamboos and trees. It is a fine bit. Incidentally it falls in with the general notion of the origin of these rift features that has been gaining ground with Dr. Teale and me. The Kungue mountains are best explained as a block that has a wedge-shaped bottom and is squeezed up by horizontal compression. Seen end on, it has the arched form that is characteristic of mountain blocks which are thus pushed up. Clouds are gathering around it now and its outlines are fading in the mist. Good-bye, Kungue. But I have a souvenir of you at dawn.

When the fat half Arab, half negro, who is captain of the *Mwanza* told me yesterday that we should arrive at Kigoma at midnight, I thought we should have this morning aboard at any rate. The *Mwanza* was towing a barge almost as big as herself, loaded with dried minnows and darkies. There was a head wind and we were glad of it. No one wanted to be down the wind from that barge, though it did make our progress slow. But the captain knew his business. The wind freshened and

shifted. We gained speed, and my watch said five minutes to twelve when the anchor dropped in Kigoma harbor. This morning I find that the watch was five minutes slow. The captain was punctual.

Kigoma is the railway terminus, the provincial and district headquarters, and also a Belgian center, since the outlet of the Belgian Congo is by this line to Dar-es-Salaam. It is a pretty village and the English officers here are very hospitable. Indeed afternoon tea with one and dinner to come with another are cutting short my time for writing.



VI

The Cruise of the Crazy Quilt

THE CRAZY QUILT

We're afloat in an Arab dhow,
A craft of splints and matches,
Of cracks and caulks and patches,
Of ropes and bark and patches,
A *shensi*[1] craft, I trow.

DR. TEALE wants me to see some geology, some rocks and structures, and he has picked out the coast of Tanganyika north of Kigoma as the place to show it. Really to see rocks and structures one must walk over them, hammer them, put a compass on them; and one cannot do that from the deck of a steamer. But one can from a dhow—a cranky, creaky, patchwork dhow—that can coast from bight to bight and put ashore at any beach. Kinsela, the obliging district officer, got the dhows—a big one, oh, an ocean liner of a dhow, and a little one that might be called a canoe.

Due at three p. m. on June twelfth, the *Crazy Quilt* arrived from Ujiji at eight a. m. on the thirteenth. We saw her coming as we sat breakfasting in our camp under the mango trees, and Dan, Teale's darky factotum, was

[1] *Shensi*, Swahili for *makeshift*.

sent to interview the captain, with whom he returned. "Much too small," Dan said of the dhow. I think he hardly relished the chances; but the more experienced captain, a powerful negro of quiet, self-reliant manner, said, "Big enough for forty men." By noon we were stowed, eighteen all told, and a ton of camp equipment. The morning breeze had freshened and our first reach was along a lee shore. I was not dhowist enough to guess how we should get off, since the craft with its bellying sail can run only before the wind; but the crew of four took to their oars, and rowing with a rhythm like real jack tars they pulled us to the entrance of the harbor, where the sail was hoisted and we stood out to sea. A squall struck us; she heeled over. The sheet and leech were cast off; the sail flew out like a banner; the captain brought the ship into the wind and she righted, but we were headed for the rocks. In Africa, however, all one has to do is to wait. We waited. The squall passed and we resumed our course under sail. Coasting the rocky shore closely, we came into Rembra bay.

During the afternoon we scrambled along the shore, under low bluffs, over big rocks, or through thickets. There are two series of rocks here: a white quartzite and a red sandstone. The one is pre-Cambrian, the other probably Triassic, and of course the latter normally lies on top of and across the other. But along the lake the pre-Cambrian is thrust over the Triassic on numerous low-angle faults. The strips are narrow and cut across

by high-angle upthrust faults, making an intricate mosaic, which in turn is dislocated by normal landslide faults toward the lake. It is a beautiful puzzle, as I am sure you will agree.

Having rounded a precipitous point, where Dr. and Mrs. Teale were delayed, the Old Man Me and the Boy who is his inseparable companion reached a charming little cove with a pebbly beach. A screen of thorn stretched between the beach and a meadow, beyond which were rocks I wanted to see. The tall meadow grass was conveniently trampled down.

"How jolly," said the Boy.

"Hold on," said the Old Man. "Rhinos or hippos have been here."

"Then maybe we'll find one," cried the Boy, and he peeked round the next turn.

"Or he'll find you," replied the Old Man. "Go slow now. It's bad dodging in this tangle." But the hippo was not there.

"Just my luck," said the Boy.

Evening comes.

The golden light is fading beyond Tanganyika's waves that break close to the tent. A more peaceful, restful scene could not be imagined.

> The rising sun is setting in the far-off west
> The rhino's in his downy nest,
> The graceful croc and the hippo cow,
> Lightly skip from bough to bough.

Yesterday afternoon we were joined by the *Dhowlett*, a small replica of the *Crazy Quilt*, in which we are to make our geological excursions while the big boat takes the outfit from camp to camp. The *Dhowlett* has not grown beyond the status of a dugout canoe, but since she sports a sail she has graduated from canoe to dhow. Her crew of four, including the steersman, send her along at a good pace with poles or paddles, preferring poles where the depth permits. But I like the paddling best, for then they sing a chanty and two of them sitting side by side in the bow keep time by striking the side of the canoe twice on each recovery of the stroke. The rhythmic knock-knock, chanty, knock-knock is quite stirring. The steersman sets the pace, chanting brief exhortations, and the bowmen respond in unison or sometimes as in part singing, the bass coming out strong.

This morning their responses sounded to me like:

Tuya la la mlung
Tuya funga mla mlung

Tuya funga manga
Tuya do da mi
Tuya la la mrong
Tuya la
Tuya la la mrong

The lake can get up quite a sea and the crew have to handle the *Dhowlett* skillfully and powerfully. She seems more cranky than she really is, and when the wind comes

across the lake, as it does every afternoon, she gives quite a thrill.

After coasting and landing from time to time this morning in the *Dhowlett*, we were asked to proceed in the *Crazy Quilt* as the southwest wind had come up strong. We were carried aboard through the surf and were presently driving before the wind, the loose sail bellying way out ahead. She yawed as boats will before the wind, and she rolled as round things roll.

But is did not last long. The wind soon died down to a light breeze and the dhow, drifting before it, seemed almost becalmed. The sun blazed down. We are only four and a half degrees south of the equator. Have you ever been becalmed on a summer day in northern latitudes? Was it warm even there? Silence fell on the boat. Dr. and Mrs. Teale looked stupified. Mrs. Teale pulled a canvas coat over her, her khaki dress lacking the spine pad that protects us. The naked negro beside me bailed from time to time and the sunlight broke on the little beads of sweat on his back. The captain crouched under his little black awning, steering. Watching the sail, the crew, and the shores, I envied a family of baboons, big black fellows, who were taking their siesta in cool shade on the edge of a cliff. They stretched and climbed lazily out to points of vantage to look after us. A little farther along a bunch of large gray monkeys with very long tails were scampering about on the beach. Most of them ran away as we passed, but two old ones swung

The Crazy Quilt.

up to a branch where they sat side by side. He looked at us fixedly. She curled her tail affectionately over his back, tweaked his ear, and looked up in his face, asking him some foolish question as a woman will when a man is thinking. He gave her a push but she only snuggled closer. Quite interrupted and out of sorts, he gave her a real push and, as she grabbed the branch, he jumped down and loped away with long leaps. I understood then why monkeys are still monkeys.

The afternoon wore on and we finally landed at the mouth of the Nzasi river, our farthest north, about thirty-five miles from Kigoma. The Nzasi here crosses the five-thousand-foot range that rises east of the lake, and our object is to survey a section along the river gorge. Teale tried to come down it a year ago but found the going difficult and gave it up. We'll see what we shall see.

This is Monday, June seventeenth, and we are on our way back to Kigoma, our work done. June sixteenth was a red-letter day in our trip, for we surveyed the section along the Nzasi across the range east of Tanganyika and got very significant observations on the structure.

The walk was a delight in itself. We were gone about ten hours, though the whole distance out and back was not seven miles. But it takes time to observe closely and to discuss until you agree on the evidence. And then it was such fun splashing up the river, over gravel bars or between cliffs under the shade of tropic foliage. The

greater part of the way was through narrow gorges, one after another, the sharp ledges of the quartzite making little cascades and deep pools. We followed our guide as long as he did not raise his one garment above his waist, but we declined deeper immersion and in two places cut a trail over the rocks. The guide was a slender black, very agile and sure-footed. Our clumsy boots did not grip as his toes did, and he had also the advantage of not being water-shy. Out of regard for our conventions he wore a strip of thin black cotton, which passed under one arm and was tied on the other shoulder. It fell to knee length and he held it around him when in presence, so to speak. The natives we met along the river wore nothing at all. We came upon two of them squatting over a bit of fire, their spears and fish nets leaning against a rock. One of them was enjoying a real pinch of snuff, his nostrils being pinched in a split stick—"to prolong the agony," as Teale explained.

These people are the Wahas, a tribe that occupies a fertile area free from the tsetse and that keeps cattle but makes no use whatever of the milk, meat, or hide. They have not changed in any respect, although they live within twenty miles of the railroad and a generation has grown old in contact with whites.

We stopped about two p. m. for the inevitable tea and lunch, but pushed on clear through the quartzite range to where we overlooked the Waha country, the open grassy ranges. Then we turned back into the shady

gorges, the swift rapids, and deep, inviting pools. Mrs. Teale, thoughtful English lady that she is, had tea ready for us on our arrival at six o'clock, and dinner followed at eight when we had had plenty of time to bathe and put on our dress suits.

This is morning of June eighteenth, our second day on the return trip to Kigoma. We hope it may be the last, for there is more work to do; but the winds will determine the issue.

We were loaded by six o'clock yesterday morning and started in the early calm, hoping for an off-shore wind. Tanganyika has the winds of the seashore: off-shore in the morning, on-shore in the afternoon. But that depends upon the sun, and yesterday clouds hid it until late morning. The favoring off-shore wind did not blow. We rowed and poled; that is, the darky crew did, to their rhythmic chant, and I, watching the slow sweep of the little oars, the blades no larger than a lady's hand, was moved to paddle with a bamboo pole. On Dr. Teale's urging, one of his boys, a parasite on his patience, also took a pole and squatting in front of me feebly moved it to and fro. Yielding to the heat and monotony he drowsed. His pole dragged. A sharp rap from mine startled him into activity. He grinned at me but soon drowsed again. Again I struck his pole. Solomon's attention was attracted. His bwana ought not to be working. It is not done in Africa. Respectfully but firmly taking

the pole from my hand, he placed himself behind the other boy where he could conveniently kick him and paddled strongly as he joined in the chant.

The wooden drum was beaten lustily from time to time to raise the wind, and it was effective. It raised a strong on-shore wind several hours before it was due, and we were forced to anchor to prevent shipwreck. By two in the afternoon camp was pitched again and we turned in to make up sleep, for Dan had beaten the pan to wake us at three-thirty in the morning. When he got his instructions last evening it occurred to Dr. Teale to give him a watch.

We have now been three hours on our way and are passing Cape Kasinga, some twelve miles north of Kigoma. There are nine hours of daylight left. Of course we can make Kigoma, even rowing. Maybe! Probably not. The on-shore wind is rising. The dhow cannot sail to windward; she cannot tack. Neither can we row to windward. Poling is more effective, but the bamboo poles will reach bottom only close to the shore and the lee shore is not too good when near. The winds will decide.

They did. Though no stronger than a fresh breeze for a dinghy, they forced us ashore before noon, and we waited till five before they died down sufficiently for the dhow to be rowed against them.

Here Dr. Teale called my attention to a queer little shelter of grass about nine inches high, consisting of long

straws tied at the top and spread for legs, supporting bunches of grass. It stood beside the path to the beach and was the home of a departed spirit. The relatives put food there, and they know he comes to get it because it is gone the next morning.

The men rowed well after the nooning and sang till one would have thought it a darky revival, but at seven we were still three miles from Kigoma and Dr. Teale ordered camp made, not relishing the prospect of landing at Kigoma after dark and waiting till ten or later for dinner. This morning we coasted cautiously into Kigoma bay and again pitched camp under the mango trees on the grassy slope. There are two days to loaf while we wait for a train to Dodoma.

VII

Ujiji

"Under the mango tree
that then stood here
Henry M. Stanley met
David Livingstone
November 10, 1871"

"I HAVE come to find you," said Stanley.

"But I am not lost," replied Livingstone.

That was the opening of the conversation, as quoted here, between the man who had forced his way across half of Africa and him who, though supposed lost or dead, was at home in the land where he had wandered for the better part of a lifetime.

It is added that when Stanley said, "I have come to take you home," Livingstone shook his head. He still had work to do.

This local tradition of the meeting is apparently more imaginary than true, yet it better fits the occasion than Stanley's formal greeting as he reports it: "Dr. Livingstone, I presume." Livingstone records only that his "whole frame thrilled."

He had been reduced by illness and thievery of all his goods to an extremity from which he saw no escape.

He feared to find himself driven, as he records, to beg from the Arabs, his enemies. Alone, his only reliance Christian resignation, surrounded by slave traders whose practice was trickery and violence, he was suddenly and unexpectedly delivered. His profound gratitude is characteristically expressed in his "Last Journals":

> I am not of a demonstrative turn—as cold, indeed, as we islanders are usually reputed to be—but the disinterested kindness of Mr. Bennett, so nobly carried into effect by Mr. Stanley, was simply overwhelming.

From November tenth to March fourteenth the two were companions in exploring Lake Tanganyika and at Ujiji after their return. They shared their interest in the unknown lakes and rivers as also in ameliorating the conditions of life of the natives by abolishing the tyranny of Arab slavers. And yet there can have been no intimate sympathy between them. Stanley personified imperious determination, Livingstone an inflexible, unwavering will sustained only by faith and endurance. The one forced his way through a difficult adventure. The other persevered patiently, in spite of illness and danger, long after adventure had become incidental, and his one remaining wish was that he might succeed before he died.

Could Livingstone now return to Ujiji he would find the slave trade gone, but the negro still enslaved by ignorance and superstition; and he could not fail to answer the call to join the men of his own stamp who so bravely carry the "white man's burden."

During their voyage on Lake Tanganyika, which Livingstone with his keen sense of humor and the experience of his arduous journeys described as a picnic, he and Stanley pondered the mystery of the Nile. Speke had seen it flowing from Lake Victoria, Baker had ascended it to Lake Albert, and each had reached the source of the mighty river, as he thought. But Livingstone believed that the true source lay far to the south and was yet to be discovered in a stream that should flow into Lake Albert. Two years previously, in 1869, he had gone west from Lake Tanganyika into an unknown country and had discovered a great river running northward for more than five hundred miles. It was the Lualaba, the southeastern branch of the Congo. The explorer for a time surmised its actual course, but hearing from natives that it flowed into a great lake he connected the latter with Lake Albert and the Lualaba with the Nile.

A map in Stanley's "How I Found Livingstone" illustrates this misconception, which Livingstone continued to entertain up to the time of his death, while still seeking the far southern sources.

We drove out to Ujiji after afternoon tea. The road runs over low hills to the rich alluvial plain that makes Ujiji a native center, and continues onward through the town for a mile under the dense shade of kapok trees. Mud houses with thatched roofs are set back just beyond the trees. Many of them are open bazaars and there lounge fat Arabs or anæmic Hindus. The population thronging the street appears black where naked, but white

Ulu.

as a rule where clothed, since a white toga-like sheet is the common garb of the native. Our chauffeur, an Indian who delighted in honking his horn and racing his motor, gathered an admiring crowd of small boys without clothing, for whom he found use when the abused engine stalled. While they pushed and he monkeyed with every accessible part to discover the trouble, we walked on.

Three white-bearded Arabs passed me, but I halted them to enquire if perchance they remembered aught of Livingstone. One of them, a very old man, recalled, it seemed, some such white man who had been at Ujiji in his boyhood, but he himself had lived many years elsewhere in various places. He was not sure.

There was little to remind him. The monument which stands where Livingstone and Stanley met under a mango tree is but a small shaft of concrete, an evidence of the loyalty of district officials who have erected it with such means as they had, but a reproach to all who honor the memory of the explorers. A shaft of Scotch granite, as enduring as Livingstone's name, should mark the spot.

VIII

A *Foot Safari*

This is July second, a week having passed since Dr. Teale and I returned to Dodoma. I am on a foot safari in the Livingstone mountains above Lake Nyasa in southern Tanganyika, with Stockley, a geologist of the Tanganyika Survey.

Before me lies a beautiful outlook over deep valleys, grassy slopes, and level skylines. There was frost this morning at camp, at the place called Mwalimos (the Teacher's), and the forty naked porters were sluggish. I have climbed over a thousand feet above camp and am sitting in a sheltered nook in the sunshine waiting for Stockley and the porters to catch up. A native has just passed. I greeted him, saying, "*Jambo*" (Swahili for "Is anything the matter?" or "How do you do"). He might answer, "*Sijambo*" ("nothing the matter"), but he says only, "*Jambo.*" He stopped, lifted his basket from his head, and placed it and his spear on the ground. He advanced a step, raised his right hand, palm out, and answered, "*Jambo, Bwana.*" Then he took up his load and spear and went on.

My immediate altitude above sea is about eight thousand feet. The hillocks on the higher levels of these plateaus reach ten thousand feet, but the skyline is

level and flat for miles and miles along the remnants of the ancient plain that was once near sea level. These are the heights northeast of Lake Nyasa that I particularly wanted to cross but scarcely hoped to, as they are off all usually traveled routes and are described as rather inaccessible. That is merely a question of ways and means, for there are no natural difficulties and native trails follow every ridge and spur.

Stockley was to come here this season and Dr. Teale arranged for him to conduct me while I undertook to consult with him in regard to his geologic problems. So we left Dodoma on June twenty-fifth in Stockley's new Ford car, accompanied by a truck driven by an Italian, Ferrari, and loaded with our camp equipment. It was understood by all that time was precious.

"See you outside Iringa!" shouted Stockley to Ferrari as we passed him. There had previously been talk of camping beyond Iringa, if possible. It was seven p. m. when we reached that pretty town, and we went to the hotel to dinner, Stockley having stationed a darky in the cold, windy street to stop the truck. The evening wore on; no truck appeared; and next morning we drove back seventy-five miles to where we had last passed it. It was not there and we returned to Iringa for another night without pajamas. On the third day we overtook Ferrari near Malangali ninety miles beyond Iringa, waiting for us. He had driven through Iringa and far into the night seeking us.

We motored on to Mdandu where the Germans once had an administrative center, fortified in a massive building. Under the castellated walls of the ruin left by the war we found forty porters waiting to take our equipment farther. They were of the race of our railway porters in America, but different. No one looking at these naked blacks could guess that they might be trained to be neatly uniformed Pullman porters or that their grandchildren could be.

The next morning, when the tents had been struck and all boxes and bales laid out in a long row, the roll call of the porters was read and it was found that two had run away. Loads were adjusted and the long line started.

"Twenty-five miles today," said Stockley.

"Do you think they'll do it?" I asked.

"They've got to," said he, confidently.

At five p. m., having lingered over geology and lunch, we overtook the porters fifteen miles out at the top of a steep climb of a thousand feet. They were seated, each man behind his load, played out. We camped in the lee of the nearest bamboo thicket. Two more porters disappeared in the night, but two bags of flour had been eaten, so we could carry on.

"We'll have a long day of it," said Stockley. "I'll send the porters by a shorter route to have camp ready for us."

He called one of his boys, a rather dull darky I thought, reminded him of a place called Ihewe where they had

camped two years ago, and told him to make camp there.

"You'll have to get a guide as you go along. It's over in that direction. It may be eighteen or twenty miles or more."

"Yes, Bwana," said the poor darky. We went our way over the valley and mountain.

"We" were Stockley, H. Todd, a young medical missionary from the Congo, who had joined us for a few days, a boy pushing a single bicycle wheel to measure the distance and carrying a knapsack with lunch, and Solomon, who carried all my instruments.

We followed footpaths over the grassy slopes and ridges, discussed the meaning of the rocks and mountain forms, lunched, and pushed on over the deeply cut valleys and long spurs of the high plateau that lay to the southwest of us.

About four o'clock we commenced to climb a steep escarpment of Uhaikwe, a very bold promontory. We climbed slowly to eight thousand feet. Thence a gradual rise over several saddles and summits carried us to nine thousand feet, just as the sun dropped below the horizon. A sharp wind swept the plateau. My bush shirt had been designed for the tropics.

Our guide, an asthmatic old negro, had faded away. Stockley was hurrying far ahead to identify the valley we must follow down to camp. He began to look indistinct in the quick darkness as Todd and I strode on

together. The boy with wheel and knapsack was far behind and Solomon was halfway between. Our shouts finally brought Stockley to a standstill till we could close up ranks and go on together. Presently the little track Stockley had struck began to descend very steeply. He stumbled, lost it, and gave up the lead to Solomon, whose bare feet could better distinguish the trodden ground. Very slowly we felt our way down in pitch darkness—down, down, down. Was that the light of our camp over yonder, or was this it, over there?

We had dropped twenty-five hundred feet to the level of native huts and presently we bumped into one. A large negro came out. *Ndio* (yes) this was Ihewe. Stockley had struck the valley. But the porters had not arrived.

"Well, Professor, what do you say? Shall we go on or stop here?" Between *rigor mortis* on the mountain side and the fever tick in the hut there was something in the latter's favor. He was not so sure.

We crawled on all fours into the low door and down toward the embers under the pot. Todd remarked that the smoke was not so thick near the ground. As my eyes got to seeing I made out a woman moving in a corner. Her skirt first caught my eye. Being of straw it reflected the little light, but it was visible only when she turned her back as it did not extend around in front beyond her hips. It was two or three inches thick but not long enough to sit on. The rest of her costume was like Eve's, a matter of inference.

Porters Winding Turbans on Which to Carry Loads. Livingstone Mountains.

Solomon, hitherto an indeterminate personality in an emergency, now came to the front. He voluntarily took charge of the culinary department, made soup of the remains of our chicken luncheon, and served us a meal of boiled corn.

Our host offered two mats, all he had, and invited us to double up as the natives did, since it was warmer so. I offered a shilling for a fire all night; Stockley and I lay down together and soon he was sleeping the sleep of innocence. I too slept for I was weary, but a scratch and a tweak of my hair roused me to slap a rat. He afterwards used my forehead as a highway, but was gone before I got him. A goat objected to our having usurped her place by the fire, but unsuccessfully. Stockley slept on.

The following day was one of enforced idleness. My suggestion that Stockley should lead an exploring expedition to find camp was vetoed by him on the ground that he could not imagine its whereabouts. Furthermore, the natives would find it more quickly. I soon learned how. Our host stood out on the hillside and shouted the word that we were there with him and wanted our porters. A voice a mile away repeated the message and it went from hill to hill, far and wide. All that little world soon knew, but our porters were not of that world. They, poor fellows, had tried to follow us; there was perhaps no nearer route. Their courage had failed on the other side of Uhaikwe, and they had not tried to cross that nine-thousand-foot ridge that night. About three

LOS ANGELES MUSEUM
EXPOSITION PARK

in the afternoon they were reported as camped a mile from where we were lounging in the sun, twenty-one miles from our starting point of the previous day. Having breakfasted lightly on boiled corn and not having lunched, we were devoutly thankful for the sacramental afternoon tea when we reached camp. I then, with malice aforethought, suggested to Stockley that we examine the geology of a neighboring gorge, which he was most anxious I should see; but I found him unenthusiastic. In fact he showed an alarming lack of interest in geology.

We did the gorge next morning. A pretty nook it is, with a charming waterfall in dark green depths and cliffs of vertical strata rising straight to the grassy plateau high above the stream. The geology was simple enough, though it had given rise to strong hints of overthrust faults and complications of the rift problem, with neither of which it had anything to do.

Todd having gone on with the porters, we found camp pitched at Mwalimos, a cluster of huts and a schoolhouse. Soon after our arrival the teacher called, and after I had tried to show an interest in his work, Todd and a hymnbook relieved me—Music hath charms, etc. In a few minutes Todd was surrounded by our servants and porters who with Swahili words joined loudly in one familiar tune after another. "John Brown's Body" was my tune, Todd said, and it was sung with intense earnestness, especially by Solomon, who turns out to be a "mission boy."

When I last wrote, at Mwalimos on July second, we were headed southwest. This is July eighth. We have been to the lake and back again to the plateau over almost alpine trails, and there is much to say of the six days' trip.

The high plateau over which we have been traveling southwestward ends in the Livingstone mountains and the abrupt descent to Lake Nyasa. The summits of the Livingstones reach nine thousand feet, some of them perhaps ten thousand, and the level of Lake Nyasa is only fifteen hundred. The drop of seven or eight thousand feet is very steep and the shore of the lake is straight for many miles. These are the typical features of a rift, and I doubt if there is a more characteristic or more beautiful rift in Africa or anywhere else. To have seen it, studied its features, and found a rational explanation of them, as I think I have, is worth the trip to Africa.

From Mwalimos in the grass country we walked to Tendala, a German mission station. When the missionaries came here thirty years ago they planted trees which have grown to great size. Eucalyptus trees as large as any I have ever seen completely surround and overhang the solid brick dwelling house. They are being cut because they are too near and too dense. An avenue half a mile long and deeply shaded leads to the old brick school half a mile away. The trees made a great impression, for I have seen nothing like them in burnt-over, "bush"-grown East Africa. The Germans were driven out by the

World War and have only recently returned to Tendala. Herr Pfarrer Tramp and Frau Tramp made us welcome, housed us very comfortably in the partially ruined schoolhouse, and invited us to share their frugal supper. The raw ham that helped out the coarse bread, cold sausage, and potatoes was probably an unusual delicacy, added for us. We stayed a second night at Tendala and Stockley asked the Tramps to dine with us. His cook was sick and Solomon volunteered. We wondered what our guest thought of the dinner: soup, salmon and tomato, roast mutton, potatoes and onions, bread pudding, and coffee. Whatever they thought, they ate well. They are simple, kindly people, making a sacrifice of their family life. They have three children in Berlin, sixteen, eighteen, twenty, whom they do not expect to see for the ten years they themselves are to remain at Tendala. But it needs not only devotion but force of character to influence these Wakinga—a powerful, practical people.

The day we were at Tendala we went six miles up a mountain slope to call on the chief of the district, Mwe Musi. He lives above every one else, in a neat native hut that stands on a terrace of hard-trodden mud. A group of similar huts was near, and all about them was swept very clean. Large shade trees hung over them and bamboo grew luxuriantly along the mountain brook. The view compassed the hills and valleys for many miles. On a lower level were the school, hospital, and dwellings, planned by British authority but very neat.

Singing at Mwalimos. Solomon, Todd, and the Teacher.
Breakfast Stop on Safari, Lake Albert Rift Valley.

Mwe Musi is a tall, powerful black with a dignified manner and seemingly ready mind. He aped no English clothing, as many do, but wore only the cotton toga common among his people. He was ill and evidently weak, but his courtesy in receiving us was that of a real gentleman. At Stockley's suggestion I gave him the bright silk handkerchief I wore around my neck, but he ignored it and an attendant took it. I have since learned that that is the etiquette of acceptance of a gift by a chief. Stockley told him my age and he expressed surprise. He thought a gray old darky sitting near was not so old as I, although he had long ago given up counting his years. Pfarrer Tramp told us that only a few could count to one hundred and none beyond that, so I imagine Stockley's statement made no definite impression.

The next day we started on the two-day walk down to Lake Nyasa. I say down, for we started from sixty-five hundred feet above sea and on the second evening camped on the delta of the Rumbira river at fifteen hundred feet. But do not imagine a well-graded descent. The character of the landscape changes completely as one enters that last range next the lake. The grassy upland of the plateau gives way to sharply cut peaks and gorges of alpine declivity. There are delightful brooks, rapids, and cascades. The footpath, made by feet rather than by hand, goes way down and climbs way up again. We dropped thirty-five hundred feet and climbed four thousand to reach our first camp in a saddle

between heights of the Livingstones. The next day we dropped fifty-five hundred feet from camp to camp, but we climbed many hundred only to descend again in making the main descent. The mountains are grown with small forest trees, now in their autumn foliage; the atmosphere threw a violet haze over all the distance, and the great lake looked like burnished brass as the sun sank in the smoke of grass fires in Rhodesia. The scene was most beautiful. It was also most satisfying geologically, for the mountains told a plain, simple story of the development of this part of the Nyasa rift.

"We have been pushed up," they said, "by mighty forces within the earth, but Nyasa lagged behind." The mountains said it, the rivers roared it, and the lake acquiesced.

Here also was Banquo's ghost finally laid. His presence, though he wore the semblance of my old friend Suess, had troubled me as long as the changes of level were slight. They might result from moderate sinking of the sea level and sinking in of the basins. But ten thousand feet is too much. The assumption that the Livingstone plateau has remained steady at an original altitude while all the waters have withdrawn into the ocean caves and sea level has dropped two miles is not tenable. Old Mother Earth protests that she has not fallen away to that extent since she gave birth to monkeys and man.

The mountain people and those who live along the lake are the same, the Wakinga tribe occupying the whole

region. It is the land of Mkinga (*M-*, the singular prefix, being changed to *Wa-*, the plural: *Mtu*, a man; *Watu*, people). In the mountains they cultivate maize, millet, wheat, peas, and beans, and raise goats and cattle. Along the lake shore they make earthen bowls and jars. On the mountains each house stands upon a terrace excavated for it. On the delta the houses are grouped under great shade trees and the women sit together shaping the bowls by hand. They build up the form by adding lumps of clay, and as it grows they rest it in a broken bowl, which they turn on the ground as they smooth the clay to a circular form. It is a primitive potter's wheel.

I walked some twelve miles along the lake shore from Rumbira to Ikombe with a sub-chief, a tall jet-black fellow, wearing a black cotton toga ornamented by a single red stripe and a white border. He was a loquacious chap, jollied the women and talked loudly with each group of village elders. When he squatted for conversation I could only pick out a convenient stone or pile of potsherds and shoot the group. I spoiled a number of films for any other use.

We reached our camping place by the lake at Ikombe quite early, and after lunching with Stockley I got out my sketch box for a study of the blue waters, steep slopes in gold and green, and distant violet peaks—a most beautiful scene. I was getting well into my subject when a drum began to beat in the village close at hand.

It was a big, deep-voiced drum. Then a smaller one joined in. I wondered if it were a funeral and I ought to attend. But the drum came nearer, I could hear the people shouting, and presently the entire village appeared advancing through the banana grove. It was a sort of impromptu jolly-up dance. The costumes were of all sorts, mostly lacking, but the three village elders wore togas and scraps of English outfits, such as shoes, golf stockings, and old hats. The dancing girls were not absent. Two exuberantly buxom maidens were particularly active and in evidence. They wore a narrow strip of bark fore and aft, supported by a bark string. Perhaps, had they had more warning they might have added a shell necklace, but having simply risen from their shaping of pots they were in everyday attire.

The crowd circled round us, chasséd up to us, broke and mingled in hilarious delight. An immense negro carried the tom-tom and dashed hither and thither with all kinds of antics. They were having such a good time. After I had taken a couple of kodaks and we had watched them awhile I went back to my sketching and the crowd returned to the village where they kept it up for an hour or more. They made merry, the Wakinga of Ikombe.

The next day, July seventh, we climbed the escarpment of the Nyasa rift, crossed the Livingstone range, and went down into the valley beyond. It was quite a day. Starting from fifteen hundred feet we went up and down and up till we reached seven thousand feet and

down and up and down to camp at about four thousand feet. I estimated that the sum of the ups was six thousand feet and that, as I with clothing and instruments weigh about one hundred and forty pounds, I did eight hundred and forty thousand foot-pounds of work. How I got the energy out of chicken and potatoes, I do not understand. The path was never made; it has been worn by the feet of many, many women, carrying heavy loads of pottery on their heads. We saw a group followed by their lords, who stalked slowly after them. The women's loads consisted each of five pots, graduated from the largest to smallest and crated in sticks bound with bark. They made a bundle about as long as the woman and she steered it through the trees or grass as she twisted along the narrow ridge or climbed the steeps.

Toward evening we approached the green tents in the valley north of the range. They were pitched in the lowest ground in a basin where the marsh grass grew fifteen feet high and the damp, chill air settled into it. During the night the temperature dropped and dropped and Solomon brought me a quarter of an inch of ice in the morning. This is tropical Africa.

After two more days tramping in the highlands we went over the great escarpment again and once more descended to the plain at the head of Lake Nyasa. It offers a tremendous contrast to the grasslands of the high plateau. The rich volcanic soil, an abundant rainfall, and the tropic sun produce their effect upon the vegeta-

tion. We walked between walls of grass fifteen feet high, under large trees hung with air plants, through bamboo thickets, and in the village among banana trees. We were told that wild buffalo abound, that hippos gape and gambol in the rivers, and that four hundred elephants had been shot in three years by the official hunter to protect the native crops. Elephants like sweet potatoes and corn on the cob, you know.

We were to be met by a motor truck at Mwaya, where the steamer calls once in four weeks and the road from the north ends. It was twelve miles across to Mwaya, twelve wet and muddy miles. We sent the porters by that route, but for ourselves we accepted the offer of a canoe from the Matima Mission.

Matima is one of the German missions that is being rebuilt. It is not far from the lake, in an extensive clearing that permits one to see the superb view of the waters stretching south to the horizon and the violet peaks of the Livingstone mountains receding along the eastern shore. Herr Betermann, a powerful young Berliner, and his *gemütliche Frau* made us welcome and chatted with us over the coffee in their thoroughly German surroundings. He spoke good English, but she was evidently glad to find a visitor who could talk with her in her native tongue. They cheerfully look forward to spending their lives in this natural paradise. Whether they make it a human paradise will depend largely on themselves. There is the opportunity if they have the wisdom and the under-

standing. "*Gott segne unsere Arbeit*" says the motto on the wall.

The canoe they kindly lent us was a crooked hollow tree, manned by five powerful negroes who threw their strength into the rhythmic strokes of their slender paddles and struck the side of the boat in unison on the recovery. It was exhilarating and not without excitement as the swells rolled the log and the whitecaps broke over the side. We had a good laugh at one of Stockley's boys, who made one too many when we pushed off through the surf and was ordered to get out. He did not hesitate and got thoroughly ducked in his haste.

It happened to be steamer day at Mwaya, whereby hangs a warning regarding making dates in British East Africa. By published schedule the steamer was to have called at Mwaya on July fourth and I had my plans laid at one time to take her on that date. This was July eleventh and there she was. I could imagine myself having sat on that reedy shore in the tropic sun, day after day, waiting.

But it being a festive occasion, all the world was there. The D. O. (District Officer) had come down and was lunching on board. Several hundred natives, Arabs, and nondescripts, squatted or strolled on the beach. The most striking figures were the jet-black ladies whose color was set off by shining coils of copper wound round their waists. The wire was an inch in diameter and they bore from three to five complete turns of it resting on

their hip bones. The weight one would get accustomed to, but the early morning chill and noontide heat of that metallic casing must tax the vitality, even of these plump ladies. It is not adornment merely; it is their dowry, thus securely theirs through life.

The motor truck was there as ordered and when our porters, wet, muddy, and weary, had straggled in we drove during the evening hours to Tukuyu, up about four thousand feet in the cool hills.

It certainly was kind of Mr. and Mrs. Masters to have dinner for us on our arrival at Tukuyu after nine p. m., even though Mr. Masters, coffee planter, general storekeeper, and garage owner, had sent his truck to meet us. English hospitality in these pioneer outposts still throbs with the traditional heartiness.

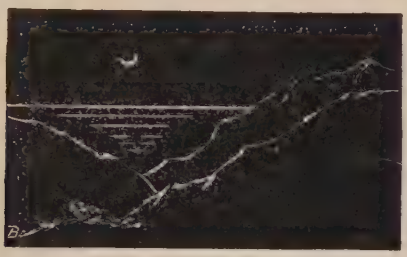
Driving north from Tukuyu we skirted the western slopes of broad Rungwe, a volcanic mass, and passed on to our objective, Mt. Mbeya.

I had seen Mt. Mbeya before, when driving by with Dr. Teale, and it had called me. A great angular mass of rock with one corner tilted to an altitude of ten thousand feet, it stands out like the horn of a unicorn from the forehead of Tanganyika. It stands, moreover, at the corner where two great rift valleys meet, a strategic position where the forces that cause rifts (whatever they are) would be concentrated and would be most characteristically expressed in the structure of the mountain. To unriddle those forces is my problem and to miss Mbeya

Belles of Nyasaland.

was to lose a very significant clue. So I reasoned and so it proved. When Stockley and I had climbed and mapped its slopes on two successive days, he admitted that he had seen evidence of upthrusts he had never expected to see, and that some rifts must be caused by compression of the earth's crust rather than by tension. Mt. Mbeya is thrust up by pressure from the north. Far to the northwest Dr. Teale and I saw proof of pressure from the east. The center from which those pressures radiate lies south of Lake Victoria Nyanza, where it ought to, according to certain theories.

The study of Mt. Mbeya finished up two months of field work covering the southern half of the great rift valley systems. It has been good fun and most satisfactory, though more questions have been raised than settled.



IX

Rhodesia and the Congo

DRIVING eight hundred miles of the Cape-to-Cairo road at an average speed of seventeen miles an hour across Northern Rhodesia suggests the monotony of a Boer trek. As an ox to a race horse so is that drive to speeding down a California highway. The country is flat, flatter, flattest. The bush is scrub, scrubbier, scrubbiest. The road is worse, worser, worsest. And my driver, "Plateglass" Smith, was deliberate, deliberater, deliberatest. "I intend to get you there," said he, as he went into low gear a hundred yards from a bumpy bridge. And he did eventually.

I dubbed him "Plateglass" because he would never, I was sure, break down with the plate-glass Buick I proposed to order for him. He was, however, an old African and beguiled the road with happy hunting stories.

"I don't mind," said he, "going up against big game with a man who does as I tell him. But when it's my life as well as his I don't like foolishness. There was a New Zealander whom I had led up to everything except an elephant. Elephants happened to be scarce just there, and it was some time before we tracked them. When we did we climbed an anthill and there was one at sixty

yards. 'You can't shoot that one,' said I, 'That's a cow.' But he must have his elephant and he shot her through the shoulders. Her screams brought thirty boiling up out of the *donga* close by. Then we were in for trouble. I don't like foolishness."

We had one delightful overnight at Chitambe Mission with Mr. Moffatt, a grandson of the great missionary who was Livingstone's father-in-law. Livingstone died not far from Chitambe, as the faithful natives carrying him strove to reach a white medicine man. So the spirit of Livingstone was felt rather than invoked while Mr. Moffatt and I talked over his pleasant fire far into the evening. He had been to America, to Hampton and Tuskeegee. He was full of enthusiasm for their practical work. He found lessons to apply to his work here. Yet he felt the problem of advancing the African black to the position of the American colored man to be a grave problem. The American had advanced so far; the African lives in such a different environment.

We drove to Broken Hill, named after the similar ore deposits in Australia and now almost more widely known as the place where the skull of an ancient miner, the Rhodesian man, was found in old workings. The mine is in operation with methods that would cause the miner of the stone age to deify Bancroft, the manager, and all his force. It is the headquarters of the Anglo-American Exploration Company, which has a mineral concession to one hundred and sixty thousand square

miles of Rhodesian territory and is combing it geologically, literally with a fine-toothed comb. Day after day the corps of nearly a hundred young geologists and several hundred blacks searches systematically through the tall grass, through thorn-bush scrub, in swamps and over torrid steppes, to locate and describe every projecting rock. Lions, leopards, rhinos, and snakes are part of the game, and it is a successful game. Large copper deposits have been discovered where I, in four days driving, did not see enough rock to know what I was passing over.

From Broken Hill, Solomon and I took the train to Livingstone, just beyond which, across the Zambesi, is the Victoria Falls Hotel. Here Solomon awaits my return from a trip to the International Geological Congress at Pretoria, passage of a negro into South Africa being hedged about with all the difficulties white ingenuity can devise.

He looked like a lost child when I left him on the railway platform. Neither Swahili nor his native language is of any use here. He knows no one. He is decidedly not wanted around the hotel, where service brings tips. But he is registered with the immigration officer according to law, has been examined for contagious diseases, and is directed to a compound in which natives live, outside the city. He had one pound ten in his pocket to keep him a month. His position is that of an interned war suspect, at liberty within limits, but it does not differ from that of any other native in Rhodesia, except that he is

not used to it. I wonder how much beer he will drink and how he will come out of possible fights, but I am not worried about him. He has thus far shown a marked capacity to take care of himself as well as of me.

Back at Victoria Falls after a month in the Transvaal attending the Congress and taking the excursions. The best part of these meetings is not in telling some skeptic what one thinks about the unknown, but in listening readily, however skeptically, to what he thinks. One is very apt to stumble on to some truth one has overlooked. At least that is my experience.

Solomon is here to meet me. He is very "sorrowful." It seems that the morning I left here after giving him a pound note, he curled up on the platform like a big black dog and went to sleep in the sun. When he was awakened by the up train, which he was to take across the river to Livingstone, he discovered that the pound was gone. Ten shillings remained to him, and on that he had made out to live, but he was in debt for his lodging in the native compound.

He is very "sorrowful." So am I. What is the proper thing to do? Solomon gets forty shillings a month for wages and fifteen for *posho*, or food. I decide to split the loss and have excused myself to Solomon in this wise: You were very careless to go to sleep and let somebody pick your pocket. I take ten shillings out of your wages for that. But I lose the other ten shillings because I gave

you the money here on the platform where anyone could see.

I cannot discover that Solomon has been drinking beer or fighting. Perhaps he hadn't the wherewithal or perhaps he doesn't. That reservation in his former bwana's recommendation may have been inserted on general principles of distrust, like the reservations introduced by the United States Senate into various treaties intended to promote mutual confidence.

I have lingered five days at the Victoria Hotel, doing the Falls as tourists do—photographing, sketching, climbing where I listed, and flying. There is nothing just like the Falls and the gorges, in my experience or in that of anyone else, I imagine. They are unique.

Some one has said: "You can see all of Niagara in one look, but Victoria Falls cannot be seen in a hundred." There is some truth in it. One might also say that Niagara's grandeur is imposing because it is simple, whereas Victoria Falls, if less imposing, offers greater variety.

The Zambesi, a mile and a quarter wide above the Falls, flows toward them in many shallow channels, surrounding islands, tossing in little rapids, or reflecting the palms and rich verdure. Islands and points of rock break the current at the very edge of the leap. Cataract and Livingstone islands are reached by canoes, and one can wander along their precipitous margins overlooking the tumult of waters in the First Gorge

There is no misnomer about that word "gorge." It is scarcely as wide as it is deep—four hundred and twenty feet. The walls are vertical or overhanging in many places. So deep and narrow is it that when the river is high the gorge is completely filled with spray and the cascade is hidden from sight. I counted it good fortune that the water was very low. I could reach points otherwise quite inaccessible and saw many exquisite details.

Had the water been higher it would have been impossible to stand out on the farthest jutting point of cliff opposite the Main Cataract and be in the center of a rainbow. Rainbows are many and varied in form and color. At two in the afternoon one springs from the foam of the main cataract and descends to the depths below the Devil's Cataract. There against the blue-black basalt cliff it suggests burnished brass. "It is fire," almost whispered Solomon, behind me on Cataract Island. When the full moon is overhead they are ghosts of rainbows, pale, ethereal arcs of light. They rise from the dark gulf where ghostly clouds toss, and arch overhead to end almost at one's feet. The pot of gold, if one found it, would be phantom gold.

At high water the Rain forest across the gorge is drenched in torrential mist and more nearly deserves its name than now, when visitors' summer dresses emerge still fresh. And then the volume of water that gathers in the First Gorge is a mighty flood that rushes with

violence into the Boiling Pool, the site of an ancient cascade.

The gorges—there are five that are numbered and a hundred or more altogether—zigzag through the basalt plateau for forty miles and record the recession of the Falls during the past few hundred thousand years. The Main Cataract, the Eastern Falls, and the Devil's Cataract are but replicas of hundreds that have preceded them, and they also will give way as a new gorge is cut across the channel of the Zambesi above the latest one. The waters that ripple so gently to the verge and leap so gaily into sunlit spray are doing their work. The hotel will have to move upstream a thousand years hence.

Flying at the Falls is a sport indulged in by those who seek a thrill or who wish a bird's-eye view of the gorges. I belong to both groups. Though not especially thrilled, I did enjoy the sensation of rising, banking, and returning over the scene.

The bird's-eye view is the major interest. Seen from a height the Falls are less impressive than when one hangs one's legs over the cliff beside the Main Cascade, and one cannot distinguish the details of the dance of the waters; but the general relations become plain. The eye follows from gorge to gorge, tracing the retreat of the Falls, and one distinguishes the sites of vanished, silenced cascades. It is the view for the geologist, the historian, not for the artist. When we had once more reached terra firma Colonel Roxburgh Smith, the pilot,

said something about a squirrel in a cage. "I thought you were going to jump out of the plane." said he, plaintively. He is apparently used to lay figures as passengers. My kodak is not built to resist a hundred-mile wind, and I had to stand up and turn around to get any photographs. And then I had to dodge the plane itself. I can buy better ones than I got, but then they would not be mine.

The most enjoyable hour was spent beside the Main Cataract with nothing between me and that symbol of force. Between jagged points of rock the smooth current bends over the brink, leaps into a myriad of falling jets that seize partners from the air and whirl into the dance of foam. Lost in the tossing masses, they rise and fall in clouds of mist that fill the gorge and balance to the rhythm of the winds. The roar shuts out the little things, the chatter of the tourists behind one, and one is alone in the "Sounding Smoke." So the native name is translated.

From Victoria Falls northward the railroad traverses the bush of Northern Rhodesia, now the scene of exploration for copper and other deposits. Some deposits have been found and others will be, but it is probable that the original discoveries will be few. The "old miners," whoever they were, did a very thorough job of prospecting. They worked the workable deposits as far as water permitted, and it is estimated they took out many millions

in native gold. Did they build Zimbabwe? Was it a temple, a treasure house, a fortress, or all three? Was a group of aliens overwhelmed there by natives whom they had oppressed? Who were they—Phœnicians, Egyptians, or servants of King Solomon or of the Queen of Sheba?

According to Miss Thompson, who ought to know, the builders of Zimbabwe were none of these, but native Bantus. If that is so, did a great dynasty of black kings establish peace and promote prosperity as none has ever been able to do during later ages? Did the arts of mining and working metals filter in from Ur or Egypt? Did the accumulated wealth attract the cupidity of some Semitic Cortez or Pizarro, and did the negro state go down in blood as the Incas did?

One's thought turns not only to Mexico and Peru but also to Ankor, that lost city of Cambodia, where the administrative and artistic genius of the Khmers flowered so richly and died so mysteriously. These instances demonstrate the latent powers of the human race and also the conditions of peace under which they bear fruit, in contrast to those of war by which they perish.

My colleagues who came north beyond the Falls were particularly interested in mines and minerals. Most of them had preceded me and had been collecting specimens for their museums while I was playing truant. I would rather sketch any day than examine a hole in the ground. We met again at Elizabethville, the metropolis du Haut

Katanga, where they were busy once more visiting the great copper mines. They came back with bits of green and blue rock, carbonates, silicates, what-is-it-ates that are silent regarding their family connections and previous conditions of existence. Rocks, like people, are of little interest unless they tell something; at least so it is with me, and that is why I was willing my friends should have my share of them. If I could have penetrated the secrets of their family history it would have been different, but that would have required an intimacy the authorities of les Mines du Haut Katanga would not readily permit. In contrast to their British colleagues the Belgian mine owners are jealous guardians.

My fellow traveler coming north was a black-haired Scot from the Hebrides, but for the later half of his fifty-odd years a dweller in the Transvaal. We made common cause in meeting the vexations of the Belgian station master at the frontier, the first deliberately rude official I have met in Africa. My Sunday and Monday in Elizabethville have been spent walking with him through the shaded residence streets, or shopping in the business center in disorderly department stores, or writing letters at a table on the sidewalk, Parisian fashion.

This journal, like me, keeps moving on. On leaving Elizabethville poor Solomon had a dreadful fright. He very nearly got left in that dreadful French-speaking community, with no friends and only a few francs for posho in his shirt pocket. It was all his bwana's fault.

That individual had made sure that his own place on the train was reserved and his hand baggage on board. Quite pleased with the situation, he was sauntering up and down the platform making mental notes of the mixed peoples who were hurrying to and fro, quite oblivious of the fact that he had Solomon's ticket in his pocket and that faithful servant had been left outside the barriers. What Solomon suffered he never afterwards was able to express. A very hurried, insistent native ventured to detain the tail of the bwana's bush shirt as that gentleman was about to enter the train. It was the last moment. The bwana pulled, but the native held on. Turning, the bwana caught sight of Solomon's agonized face pressed against the bars, and remembered the ticket. Fortunately trains in the Congo give plenty of warning before starting.

We are afloat on the Congo river, having come down the Lualaba to its junction with the Luvua. This is Saturday. We left Elizabethville Tuesday noon by train, took the boat Wednesday at Bukama, and might have been voyaging down the Mississippi with Mark Twain these four days, except that there is no Mark on board. But here is the stern-wheeler and here are the darkeys to lend appropriate color to the scene. A few crocodiles, some antelope, a lion strolling along the bank, suggest an escaped circus. Dense masses of feathery papyrus, palm trees, and the unintelligible cries of natives

as we pass their villages are merely stage scenery designed to persuade us that we are in Africa. We shall land at New Orleans tomorrow and I shall call up home on long distance.

Fond hope! Tomorrow I shall be en route by train from Kabalo to Albertville and this bit of the journal will be waiting at Kabalo for the air mail to Boma, Bas-Congo, and so to Antwerp and New York. From Albertville I shall cross Lake Tanganyika to Kigoma to greet once more the friends there and to meet Arthur Combe, geologist of the Uganda Survey, with whom I am going north on a foot safari through the eastern edge of the Belgian Congo, past the great volcanoes of the Mfumbiro range, past snow-capped Ruwenzori, and on to Lake Albert, Wayland's rift valley.

X

Into the African Frontier

LOOKING back over excursions that I have made from time to time in various lands, I find it difficult to distinguish one that I have approached with more interest, not to say enthusiasm, than the one we are about to set out upon.

The autumn of 1880 is a living memory. That trip without other companions than Indians in what was then the northwest wilderness—the birchbark canoe, the rapids, the Indian village scenes—all made a deep impression on the green boy fresh from college and city.

During the years of opportunity that have since elapsed the long trail has lain through many lands beyond my own —through Europe, Asia, the Far Southeast, and South America—always leading to new aspects of world problems, whether scientific or human. Africa alone of all the continents remained unvisited, and yet it was Africa that made the earliest appeal to me. When in my childhood my mother read me the story of Sir Samuel Baker's exploration of the Nile she created the figure of a hero in my mind, she imparted to me something of her own enthusiasm for the Englishmen who have dared every danger to penetrate the unknown.

And now I, too, in this late day am headed for the sources of the Nile. The unknown of Sir Samuel's day stands unveiled long since. But, even as in life's long vista one achievement discloses another objective, so the discovery of the sources of the Nile has uncovered the deeper problems: Why the Nile? why the lakes in which it rises? why the strange landscapes of East Africa, that excite the curiosity of travelers?

There comes to mind the figure of little Paul du Chaillu, the dark, slender, wasted figure. He knew the equatorial forests. He had met pigmies and gorillas. At least he said so, and the incredulous who said he lied have been proved wrong. There are pigmies and gorillas, and I am going where I may see them.

Then there are the fabled Mountains of the Moon. I shall visit them. It does not matter whether Ptolemy meant the Mfumbiro volcanoes or Mt. Ruwenzori; I shall see them both. Is it not fascinating? Will you not come with me?

Kigoma is the western terminus of the railroad that starts from Dar-es-Salaam on the East Coast. The two places bear to each other the same relation as New York and San Francisco, so far as the commerce of the country is concerned. The town of Kigoma was laid out by the Germans, but it is completely anglicized, and the British rule themselves as they rule others, according to established custom.

The other nine-tenths of Kigoma's population is black and naked. The wharf and streets are full of Wahas, whose homes are in a fertile district twenty to fifty or more miles northeast. They are very black, slight but sinewy, and active. They habitually wear a skin, from calf or antelope or leopard, slung from one shoulder across the other hip. Usually they wear nothing else, but some find it more convenient to adopt a cast-off pair of shorts. They are at hand to work at the beckoning of a finger. Lines of them pass up and down the streets with jars or cans of water; they carry up your baggage; they load and unload vessels, and are indispensable.

At home the Wahas are cattle herders and agriculturists. They practice irrigation. Mr. Bagnall, the provincial commissioner, even hopes they may raise coffee successfully.

There is also a little group of Belgian officials at Kigoma, exiles almost. They have no social relations with the British and turn their faces westward to the Congo, to their fellow countrymen. The difference of language isolates them more than diversity of customs.

The run from Kigoma to Uvira was not without its interest. Lake Tanganyika is a large body of water and the crowded little steamer seemed a tiny craft to carry so many souls, white and black. I was one of the many who slept on deck, but more fortunate than most I had my own bed and mosquito net. Solomon put my cot along the rail with the mosquito frame tied to it. I slipped inside and soon knew nothing of the night.

B-o-o-m, b-o-o-m.! went the unfamiliar sound of thunder. It was daybreak. A thunder squall was upon us, preceding a black mass of rain. Figuratively speaking, I was up the ratlines in a jiffy, furled sail, and made all snug instanter. Solomon ran up from the forward deck in time to help me roll the cot and blankets in their canvas as the first big drops came, and a bright flash was followed closely by a crash of thunder. I looked at him and smiled. I have yet to learn that he is familiar with thunderstorms. In any case he is not afraid. Standing in a protected place we watched with amusement the hurry-scurry of the less fortunate. The little steamer was headed into the wind and quite steady. There was no sea. When the sky cleared the reason was obvious. We were in a narrow bay between towering mountains, where there was no fetch to the waves.

The morning was very beautiful and the setting superb. The western shore was precipitous, suggesting an Alpine scene without snow peaks, and a range of even height formed the peninsula that jutted northward on our eastern hand. It was the first time that Lake Tanganyika had justified to me its name of rift valley. In general its shores are as tame as the English lakes. The range holds on to Uvira, which lies at its foot in a fine position.

At Uvira there were no Wahas eager to take our boxes. The natives held aloof. We dickered with Belgian truck owners as one might in Europe. Lest you con-

clude that Uvira is better organized than Kigoma, let me hasten to add that native service in the hotel is conspicuous by its absence. The wretched proprietor may have six untrained boys this morning and none this afternoon. They do not know knife or fork, sugar or salt, coffee or tea, by name. They saunter in to earn a few centimes and saunter back to their village at pleasure.

We three, Combe, Bowen, and I, had agreed on the division of labor on landing: Bowen to get baggage ashore, Combe to engage transport, I to speed to the hotel where rooms would be at a premium. The boat had not touched before I stepped from the rail of the lower deck around a group of piles and, coming apparently from the wharf, mingled unquestioned with the crowd. I was the first man ashore and by all odds the first at the hotel. Two hours later a distracted official scolded me volubly in French for having evaded the immigration officer. I might have brought in smallpox or Heaven only knows what! *Sacrebleu!*

Combe's great bulk was promptly challenged as he tried to cross on the gangway, and he was ordered back on board. We were among the last to get away and got well soaked by the eleven o'clock shower. I say "we," for, of course, I had gone back from the hotel.

We stayed but one night at Uvira, but I managed during the afternoon before and the morning following it to examine the mountains and to read their story in part. Like the Livingstone mountains above Lake Nyasa

these heights are young. They are equally sharply sculptured and offer fascinating canyons to explore, if one but had time. We had not, yet Bowen and I enjoyed a glimpse into their recesses from a spur eleven hundred feet above the lake. Across its expanse we could see the approach of the daily thunder shower warning us to return, and we did not linger.

An astonishingly good road, eighty miles long, has been built from Uvira to Bukavu on Lake Kivu, or Costermansville, as it has been rechristened officially. We came up by motor, following the valley of the Ruzizi river as far as it lies in the Tanganyika depression, but climbing out of it on a winding grade where it changes to a steep-walled gorge. We were quite unprepared for the sensational character of the scenery. The Ruzizi drops twenty-six hundred feet from Lake Kivu to Tanganyika, practically all of the fall being in the upper half of its course. Considered as a river the Ruzizi is but an infant. Not long ago Lake Kivu (or rather the valley it fills) drained northward to the Nile. But volcanoes arose along its course, their lava flows laid a dam across the valley, and it became a lake basin. In a few decades the waters rose to a low pass at the southern end, flowed out there, and produced the Ruzizi river. Its deep gorge is a fine example of youth.

Bukavu is a name you will hardly find on any map. It is the frontier village at which the road from Lake Tanganyika to Lake Kivu ends, and it reminds one of a

new gold-rush or oil-boom town. Tin shanties are the rule, but an avenue of young trees and a few brick buildings hint the future of the city. Future is the word that describes the hope of every activity. Nothing really *is* at Bukavu. It is all *to be*, and as usual it is all to be great. Many years have passed since I have seen anything so like the Far West as I once knew it, so raw, so riotous, so lacking in organization, so ambitious.

The setting is fine. Lake Kivu ends in several small but deep embayments between grassy peninsulas. On one of the latter, a hundred feet or so above the lake, is laid out the main street, the avenue; but, as there is room for only one row of houses on either side, the town spreads out at its end. Extensive coffee plantations and banana groves occupy the future sites of the Hotel Ritz de Kivu, of the banks and commercial houses, and of Thomas Cook & Son, Ltd., who in 1950 will charge you one hundred per cent commission on your ticket by the train de luxe to Cairo.

I had one delicious day out from Bukavu. Alone with Solomon I climbed the near-by hills to sixteen hundred feet above the lake, drank in the beauty of the luxuriant land, studied the meaning of mountain and plain, and made friendly links with the people in the fields and villages. I was reminded of days in China twenty-five years ago after we had learned not to be afraid of the unfamiliar environment. The simple peasants were quick to respond to a smile and greeting.

It was four in the afternoon. I had stopped to photograph the gorge of the Ruzizi and a group of natives had gathered to watch proceedings. Presently I beckoned to me the oldest, a grizzled old boy, and showed him the others in the view finder. He was greatly puzzled at first to see them so small and to see them change size as he looked through or over the finder. After repeated dodging up and down he got excited, slapped his nakedness variously, laughed hilariously, and looked at me with a most lovely grimace. Of course, the others had to see also and we all laughed together. But I broke away to get back where I could have a bite. Since breakfast at seven I had eaten two little cold potatoes without salt or drink. I strode away toward Bukavu. I had gone nearly half a mile when the old boy overtook me, bringing bananas. Good old boy!

The kaleidoscope has turned and the picture is changed. I left Bukavu at six-thirty this morning and we are now here on a hillside near the western shore of Lake Kivu. "We" are Dr. Houbart, a chauffeur, Solomon, several boys of the Doctor's, and a motherless little fellow whom the doctor has picked up.

Let me introduce Dr. Houbart. A Walloon, something over six feet, powerfully built, light, curly-haired, and boyish looking, he is perhaps twenty-seven, smiles on the world happily, and talks French with an impossible accent. At this moment we have run out of gas, the

essential "essence," and the Chevrolet motor refuses to work. But a Fiat comes, goes to the nearest plantation, and refills our tank. "*C'est bon*"

Dr. Houbart is physician and temporarily general manager of the estates of La Linea, which belong to Prince Eugene de Ligne of Belgium. I was courteously given a letter of introduction. Dr. Houbart has taken me on and we are en route to the enchanted Isle of Kwidjwi in Lake Kivu.

The island is about twenty-five miles long by five or six across in its main body; but like other submerged mountain groups it has long arms and deep bays. Its negro population is guessed at three to twenty thousand. No one knows. The larger number live on the lower hills, but many still hide in the forests on the mountain, among them pigmy tribes

Kwidjwi received me. What did I wish to do, to see?

I would climb a mountain, the highest; penetrate the forest, the deepest; see the pigmy at home and a gorilla in his nest.

"*Mille regrets.*" Kwidjwi had no gorillas, but all the rest was easy. Evening found Dr. Houbart and myself camped on the shore of an exquisite cove where the shadows of great trees stretched across white sands and rippling waters in the moonlight.

In the morning we took a native trail back into the hills. All the lower ridges have been cleared by annual

Dr. Houbart, Solomon, and the Pigmy.

fires and are dotted with little patches of potatoes or peanuts, or are grown up in bananas and elephant grass. On top of a spur we came upon a couple of conical grass huts and a Mboto or pigmy family, so called. There are pigmies and pigmies. Some are stunted negroes, I imagine, and others are said to belong to an aboriginal race.

The father of this family was a well proportioned little man something under five feet tall. His features were rather clean cut and a small curly beard looked quite dandified. Seven wives sat grouped together tending as many babies of various ages. They paid little attention to us, though I photographed the group, but went on tending or nursing or fondling the little ones as mothers do the world over.

The little man was engaged as our guide and led us on trodden paths up and down the steep slopes, under fine forest trees or through dense thickets of tree ferns. We passed groups of a dozen or more natives hauling out logs, pulling in unison to an ejaculatory chanty. Two thousand feet above the lake we came out upon the highest peak and from a small clearing had a superb view far and wide over the island, the branching lake, and the ranges that parallel one another in the blue distance.

When I had satisfied myself as to the character of the scene that expresses the growth of mountain, valley, and lake, we ran gaily down the steeps to our camp. The huge figure of Dr. Houbart boyishly pursuing the little Mboto and followed by my grandfatherly self appeared to

surprise the monkeys, who chattered to each other in the tree tops.

The mansion house of this estate of La Linea is a four-room bungalow with thatched roof. The sitting room has a large bay window commanding a view down the lake. The site would be a choice one on the Maine coast, where a similar view of straits and islands might be had, but there the pointed firs would replace the coffee bushes.

I spent an afternoon and morning at the mansion, chiefly in company with Vicomte du Parc. The vicomte is director of the plantations and other activities on the island. With two European assistants he trains more than five hundred natives in the arts of agriculture, forestry, brickmaking, and building. Two years ago they ran from a white man; now they are to learn and adopt his ways. Their clothing, if they wore any, was a hide softened with rancid grease. The women still wear such a skirt, as it were, and it never wears out or changes fashion nor is it ever cleaned or replaced. They do not often wash. The hospital nurse, Mademoiselle Parmentier, told me they were afraid of water and when brought to the hospital protested against being bathed. Yet the men handle canoes and wade readily. The contradiction might perhaps be traced to some superstition. Be that as it may, let those of you who have taught Dinah your ways of housekeeping reflect upon the task of converting these wildlings into self-respecting domestics and laborers.

During a long talk I had with the captain of police it appeared that the natives of the island are the least intelligent, the lowest that he has met in twenty-odd years in the Congo. This is natural. The island, like other inaccessible places, has long been a refuge to which the dull, the inefficient, the cowardly peoples have been driven. The task of civilization is there more difficult even than elsewhere.

By contrast the captain told of a tribe living west of Lake Edward, who stored provisions and cattle in the forest. For two years they fought a losing fight and only when there was nothing more to eat did they surrender.

"*Ils étaient courageux en combat et ils sont braves*," said the captain, confirming the not uncommon observation that the most resistant peoples make good subjects when conquered. It is a question of intelligence.

In the morning I saw the Kwidjwis assemble to the number of eighty. They drew up in line on a garden walk, decent-looking darkies. Some wore shorts, but the majority wore a dark blue or crimson *panne*, as one would wear a towel around the loins. The vicomte called the roll, to which they answered "*Bwana*," and he then told them off in squads, entrusting to their not very intelligent care the coffee plantations and other operations essential to the success of the company.

Again the scene changes and Kwidjwi becomes a memory. The little tugboat called for me there yester-

day, and I have come on to Kisenyi with Combe and Bowen, as well as various passengers of high and low degree. Whether high or low we were all equally crowded on the three barges that the tug drew on long tow lines, and we became hungry as evening advanced, according to our habit. Each party picnicked on what it had, in our case a cold chicken Solomon had roasted on the island.

It was a beautiful night with a full moon, and Kivu was exquisite. Toward nine o'clock we drew near to the northern end of the island. The shore had the fascination of deep shadows and offered imagination an opportunity to play. We rounded several points, each guarding a more secluded bay, and finally stopped at a native village.

"*Jusqu'a trois heures du matin,*" the captain shouted. Whereupon we tumbled ashore to find some place to snatch a few winks. It was hard on a young mother, a mere girl, whose wee baby cried and cried in a division of the resthouse separated from ours by a straw mat.

At two-thirty we went aboard again and I was fortunate in having a folding chair which, when folded up, made as good a bed as two fence rails on the iron deck. I slept soundly for three hours and was awakened by Combe, who poked his big foot into my ribs and said, "Get up and look at the volcanoes." There they were, three immense blue cones in the light of dawn.

Nina Gongo (Mother of the Congo), the great truncated cone that rolls out cumulus clouds of steam, had two vents up to 1918, when it blew its crater out.

Mikeno, the next to the northeast, has long been extinct and erosion has bared the spine and ribs of solid lava, giving the mountain a fine serrate form. Karisimbi, the largest, is also extinct, and one might not suspect its broad shoulders to be volcanic. Nina Gongo rises to eleven thousand feet, Mikeno to fourteen thousand five hundred, and Karisimbi to fourteen thousand eight hundred.

They form a magnificent forest-clad group but are only part of the great chain of active and extinct volcanoes that is known in general as the Mfumbiro volcanic district. We will spend the next three weeks among them, in the region that is as nearly aboriginal Africa as any part now remaining.

Combe has an intimate knowledge of the eastern peaks of the chain, Sabinio, Gahenga, and Muhavura, which lie beyond our vision. Sabinio and Muhavura are giants almost equal in stature to Mikeno and Karisimbi, while Gahenga, standing between them, is their lesser brother. Sabinio holds up five skeleton fingers toward the sky—hard masses of lava that cooled in the throat or fissures of its perfect form when it was active and that have long since been stripped of all looser covering.

Sabinio is the oldest of the whole chain. If, perchance, you ask how old, one must answer a million years or two. And yet Nyamlagira and Nina Gongo are being built up by the same processes, at the western end of the fissure along which the individual volcanoes are ranged. When

the fissure was opened by the fiery tongues that formed Sabinio (or opening, allowed them to escape), did it extend as far west as Nyamlagira? Or has it grown westward? Is it still a growing rift? And does the volcanic activity advance with it?

There is a chain of volcanoes in Chile, three hundred miles from end to end along the western base of the Andes. Its northern monuments are very old—contemporaries of Sabinio. The southern volcano is Osorno and, like Nyamlagira, is even now active. Are these vents also upon a growing rift?

Volcanoes, rifts, and rift valleys are often, though not always, closely related, but it is not clear whether the volcano causes the rift or the rift the volcano, or whether both rift and volcano are effects of a common cause. The latter seems more probable.

Kisenyi is a surprise. According to all accounts I had read, the northern end of Lake Kivu was the real black man's country, beyond the frontier of European penetration. Yet here is a fine avenue of shade trees along the shore, and substantial houses with walks bordered by geraniums and roses. The avenue runs straight from the Congo into Ruanda, and Ruanda before the World War was German territory. It might have been named l'Avenue internationale, but it is now all Belgian.

Here for the first time we come upon the tall, Hamitic negro, if negro he be. He is slender, stately in carriage, and his features are Semitic rather than negroid; but he is

MARKET AT KISENYI, LAKE KIVU.

as dark as the real blacks. He is the aristocrat, the overlord. His cattle are herded by his inferiors. He loafs, smokes, and has the vices of a degenerate upper class that has long lived in contact with its servants. Nevertheless, he is a picturesque dandy. There is one yonder—over six feet, very slender and straight, wrapped in a crimson blanket. His delicate chin is pointed by a long Vandyke, which is twisted and projects sharply forward. His permanent wave consists of two crescents of kinky hair, one of which starts under his left ear and crosses his crown to the right temple, while the other curves over the back of his head. He is a beau and a social parasite.

Tomorrow we start northward on safari. We are to be up at dawn and begin our camping. There are some long marches ahead, there will be weariness of muscle, but there will be none of spirit in the scenes of interest and beauty among the great volcanoes.

LAKE KIVU—MFUMBIRO VOLCANOES

The basin filled by Lake Kivu was the valley of a river which flowed northward to Lake Edward and the Nile. The Mfumbiro volcanoes, Sabinio and Mikeno, the oldest, Muhavura and Karisimbi next, and Nina Gongo and Nyamlagira, the youngest—have been built up across the river's channel, damming it. Overflowing at the southern end, the waters have cut the Ruzizi canyon, by which they now flow to Lake Tanganyika and the Congo river.

The Nyawarungu also flowed north across the site of Sabinio, but it has been obliged to turn back up the course of its former tributary from the east, and now runs up stream to the Kagera river and Lake Victoria. Lake Buleru leaps more than 300 feet at the new outlet by which it turns to the Nyawarungu.

This region has until recently been one of the most remote as it is one of the most beautiful lake and mountain scenes of Africa. The Belgian Parc Nacional Albert and the adjacent park in Uganda, which constitute the Gorilla Sanctuary, cover the volcanoes east of Lulenga where the White Fathers have befriended Akeley and other early visitors.

Sketch map drawn from Belgian official maps of les Territoires du Ruanda-Urundi.

Rutshuru
Mulagwira
Sabinio
Nyamlagira
10,025
Mikeno
14555
Karisimbi
14020
Nina Gongo
11,375
CONGO PLATEA
Kisenyi
LAKE
KIVU
4755
Kwidiwi
Linea
Nyanza
Bukavu
Astrida

XI

The Mfumbiro Volcanoes

After two days' march over the volcanic plain north of Lake Kivu, skirting the eastern base of Nina Gongo, we have arrived at Mission Tongres Ste Marie, a station of the Belgian missions of the Pères Blancs, at the place called Lulenga. When it was established here in 1907 the region was one of the most inaccessible in "darkest Africa." It had long escaped explorers for the real sources of the Nile, although here is the divide between the basin of Lake Kivu, which flows to the Congo, and that of Lake Edward, which belongs to the Nile. Livingstone and Stanley, exploring Lake Tanganyika in 1871, heard only of an unknown lake, probably Lake Kivu, which appears on Stanley's map far to the west of its real position. And yet thirty-six years later the Pères Blancs were established here. They came in on foot and by canoes. German explorers and others followed.

Carl Akeley, enthusiastic naturalist and, much more, nature lover, came years after, and the Fathers helped him in the beginning of those studies of the gorilla which have led to the establishment of the gorilla sanctuary, where, in his second expedition, Akeley died and where he lies buried in the primeval forest on Karisimbi.

Now steamers of a sort and motor tracks make the journey to Lulenga an easy one. The road is built north from the mission to Rutshuru and on beyond west of Lake Edward to the Semliki valley. Extending soon to Lake Albert, it will link up with steamers on Nile waters and will become a rival of the British Cape-to-Cairo route. Many a traveler coming from the south to Abercorn will prefer to take steamer the length of Tanganyika and proceed by motor and steamer, by Kivu and Albert, to the Nile connection, rather than to journey over the arid steppes of Tanganyika Territory.

The Fathers at Lulenga have built a resthouse at which travelers may lodge with their own equipment, and they make visitors welcome at their board. For this hospitality the guest contributes to the maintenance of the mission whatever he deems appropriate.

There are but two Fathers here now, Père G. Provoost and Père P. van den Houdt. They are earnest, practical workers, individually unlike as Belgian-French and Flemish may be in their natures, but equally devoted to teaching the natives good manners, good agriculture, and good morals. A goodly number have come under their influence as laborers and congregation. As one sees the natives come thronging up the path, clean, decent, and happy, as they gather in the morning for mass or for assignment to work, one cannot doubt that the influence of the Fathers is good. The personal qualities of these Fathers ensure control, and the authority as well

as the ceremonial of the religious service holds the negro.

It is in this region that Professor Harold Bingham of Yale is conducting an expedition for the Carnegie Institution for the purpose of studying the social habits of the gorillas. I had hoped that I might meet him, but it was thought unlikely as Bingham's camp would probably be remote. However, when we arrived here yesterday we found that he also was expected, and he and Mrs. Bingham came in shortly.

Tomorrow I go out with him to see if we can meet gorillas where they come down for wild celery. We must wait another day for porters and then we go to Nyamlagira, the active volcano whose glow is reflected from the cloud above it, looking like the light of a distant city on fire.

Today Bingham and I have been strolling for gorillas. Strolling is the word. It means, I take it, walking quietly where fancy leads, as long as fancy urges. One may stroll with a friend for the enjoyment of companionship. We were not without hope that the gorillas of Mt. Mikeno would let us join them in that spirit, though the fact that Bingham had, in self-defense, shot the father of a family only five days ago might possibly be an obstacle to cordial relations. We were not sure. We did not find out, for they were not at home, much to my regret.

Pères Blancs at Lulenga.

The gorilla's home is in the forests on the slope of Mt. Mikeno and Mt. Karisimbi. It was there that Akeley visited them and secured the representatives you may see in the American Museum of Natural History. It is in the saddle between the two volcanoes, at eleven thousand feet above sea, that he lies buried. There Burbridge captured several young, none of which lived long in captivity, and that particular saddle was chosen by Bingham for his studies of the family life and cultural status of their race.

The Binghams camped for a month in the saddle, examining trails and nests and following gorilla families in their daily migrations. As a rule they saw only black heads bobbing up and down in the bushes. Occasionally one or another would come into the open, look at them intently, and beat his chest. Some of them unconsciously posed for Mrs. Bingham's movie camera, and one little fellow climbed a tree for her.

From our point of view these are very laudable efforts of scientific research, but speaking as a self-respecting gorilla I would object. The privacy, yes the safety of my family being threatened, I would even proceed to violence. That seems to have been the decision of the gentleman who died charging the intruders.

This incident of scientific research occurred some twelve miles from the mission and five thousand feet above it. Our stroll did not take Bingham and me so far. We ascended fifteen hundred feet, past millet fields and

banana plantations, to the forest of Mt. Mikeno, and very soon came upon gorilla nests, that is, the beds they make for the night.

The forest is a forest no more until one reaches a higher level, for all the larger trees have been cut by natives and what is left is rarely more than a foot through or more than thirty feet high. The underbrush, however, is quite dense. In one group of nests that had been occupied on the same night, four were in trees and two on the ground. This interested Bingham greatly, as there is much discussion of the gorilla's habit—to what extent is he arboreal? —and Bingham had, in the higher, dense forest, found nests only on the ground. He climbed into one of them and I took his photograph posing as mama or papa gorilla, we are not sure which. Does papa nest high as a sentinel and mama sleep on the ground with the babies; or does mama climb with the babies to a safe height and papa stay on the ground for defense? The natives say the former and scientists infer the latter.

They had probably been gone about a week, since the beginning of the rains. This open woods gives little shelter. Higher up, where big trees lean out from steep slopes, there are dry nesting places, and so the family had gone up the mountain.

They had breakfasted on the way. Following the trail we found stems split open to get pith and wild celery torn up. Then they had struck an elephant's trail and gone faster. An elephant's trail is a grand path; in the huge foot-

prints everything is trodden flat and a wide lane is made through the underbrush. For six hours we followed them but had to come home without even saying how do you do.

It is September twenty-sixth. We are camped on the volcano Nyamlagira, eight thousand feet above sea. A great tree, growing in deep grass and herbage and hung with lianas, distinguishes the little flat on the mountain side. Half a dozen brown grass huts remain from visits by other travelers and shelter our gang of forty porters. Combe, Bowen, and I each have a little Whymper tent, brought especially for such side trips as this where our big tents could not well be carried.

This is the camp from which ascents are made to the summit two thousand feet above us. The volcano invites visitors, for it is not difficult of access and is the most active one of the great Mfumbiro (Vironga) group. For three nights we have looked across the valley from the Mission Tongres Ste Marie or Lulenga and watched the changing reflection of the volcanic crucible from the clouds above the crater. It varies curiously from a faint glow to the semblance of a great forest fire.

The trip from the mission to this camp occupies two days with porters, though an active man can make it easily between sunrise and sunset. The route is described as unusually difficult. It is a track, nothing more; but as forest trails go it surprised me into thinking it fairly

good. Part of it lies across a lava flow of 1905, which issued from a little cone at the base of Nyamlagira and spread into the fertile valley. The surface is formed of the crust that was broken, tossed and twisted by the hot current beneath. It is very rough, angular, and sharp —hard going for sandaled porters with loads on their heads, though not seriously difficult for well booted men.

We left the mission yesterday morning and soon entered the broken lava. It is but thinly overgrown with lichen, fern, bushes, and saplings, in contrast to the older flows on which there is dense though not large growth. The wide plain can hardly be called the Elysian fields but may well be described as elephant fields. Have you gone berrying in the old pasture where cow paths circle every clump of bushes? Here the paths are almost equally numerous and labyrinthine, but they are elephant trails. The big beasts cross the rougher lava directly, but in the denser forest they wander wherever their trunk happens to turn. We find trees twisted off or pushed over. We passed where one elephant had taken his siesta. There were imprints of the great knees in the forest mold, and the branches within reach were broken as though he had munched and dozed and munched again, in supreme contentment.

Our first camp, five hours' walk from the mission, was on the edge of a little crater near the base of Nyamlagira's slope. The crater is a water hole. Water holes are few and far between in these porous lava fields, where of

brooks there are none. This one fixes the camping spot, and it is also the pool to which the denizens of the forest come to drink at night. As we approached it the game trails joined our track from all sides until they formed one of a dozen converging highways.

Bowen remarked that it was foolhardy to camp at the only water hole within miles without a gun of any kind, but I noticed that neither Combe nor the porters showed any anxiety. The dry season is over and there are plenty of puddles, was Combe's indifferent response.

Nevertheless Old Man Me and the Boy had quite an argument as I strolled around the water hole examining the shore for tracks and looking at the approaches. The inner slopes of the little crater rise steeply from the water's edge. A great tree hangs far out over the pool. One big branch, covered with epiphytes, offered a comfortable bed not difficult to reach, yet fifty feet above the pool.

"Gee," said the Boy, "that's a grand place to watch 'em from."

"And fall on an elephant's back from," suggested the Old Man.

"He'd be surprised some, wouldn't he?" grinned the Boy. "But you're always knocking. I wouldn't fall off of there."

"You might have to jump if a leopard came up the tree."

"Give me Bowen's flashlight and a bush knife, and I wouldn't jump," replied the Boy. "But supposing I did

and the leopard came after me, which do you suppose the elephant would pick on? I bet I'd get away in the scrap."

But the Boy got sat on as usual. Combe does not know of his existence and, if he did, he would not approve of his idea of a joyful scrap.

In the morning I again examined the pool. The night before, the green barnyard scum that covered it had lain in long wind-formed curves on the smooth surface. It was stirred in; bubbles had risen from the mud and lay in eddies; and on the shore was a single fresh elephant track between the water's edge and the rock. He had bathed and drunk within fifty yards of us.

September twenty-seventh was a great day. The ascent of Nyamlagira, the crater, the storm, and the search for camp mark it with red letters. Also they called for endurance.

It began two hours before dawn. Combe has the early habit. We had noticed that Nyamlagira is usually cloud-capped before noon, and we wanted all the hours of sunshine available. We were off at six-thirty and on the summit at eight. With any but these Africans we could have been an hour earlier.

The climb up the gentle slope was surprisingly easy. It did not materially tax muscle or wind for any of us, not even up to ten thousand feet. A track through the forest and higher up through heather alternated with stretches over black lava in the dry bed of a brook. The slopes of

the summit cone are steep and bare. The last eruptions from it were of volcanic mud, which has cemented the included blocks to a very rough but firm surface.

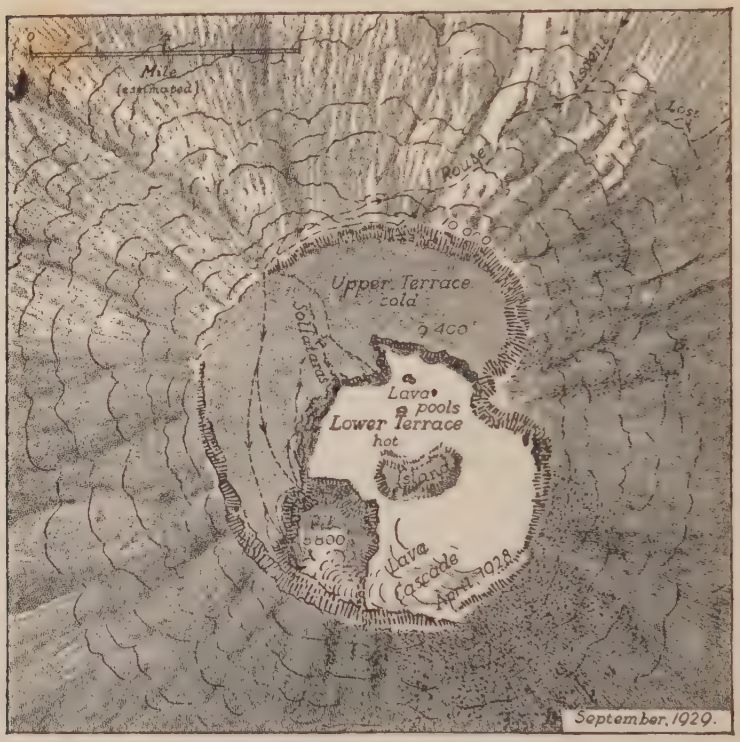
Bowen, first on the crater rim, gave a shout of delight. He is usually silent, but this was his first sight of volcanic activity at close quarters. Whatever he may have expected, this was certainly different—so large, so varied, and so suggestive. You who have looked across the caldera of Kilauea can best form an idea of the scene. Nyamlagira might be called the African Kilauea.

Vertical walls from two to six hundred feet high enclose the scene, except for an explosion vent on the west. Within are lava terraces, galleries of the theater as it were, surrounding the deep pit. From where we stood across to the far wall I estimated to be a mile and a half, more or less.

The upper terrace is cold. Its broad black surface is crossed here and there with lines of pale green vegetation growing where steam condenses in cracks beneath a soil of cinders. A single line of steaming *solfataras* marks a more active rift. Over its level one could wander at will, taking care in places not to go through the cinder crust into a hidden crevasse. Solomon followed me gingerly, after I had put one foot through and steam rose from the hole I had made.

The lower terrace is also black but hot, very hot. Just how hot it is or how strong the crust over the lava tunnels and pools that lie below the surface we did not

find out. It is not easy to get down from the upper terrace. We needed a more venturesome leader, but he might have led us into difficulties had he appeared.



Sketch map of Nyamlagira crater.

The principal activity of the volcano is now centered in the lower terrace. A large fountain of boiling lava within a black-rimmed craterlet, perhaps one hundred, perhaps two hundred feet across, marks a focal point. Scattered over the terrace are a dozen other obvious lava pools, and at night one might see a hundred or more,

CRATER OF NYAMLAGIRA.

The Deep Pit.

The Lower Terrace and Island.

besides glowing cracks. For, though the surface is chilled by air currents and by rain, molten caldrons evidently lie beneath. Steam rises in full-bodied columns or whirls into a cloud that temporarily covers the platform. With it are strong sulphur fumes.

From the lower terrace rises a crescent-shaped block, an island that is perhaps two hundred feet high. Its top reaches the level of the upper terrace and it may be a remnant of that floor. A similar mass which stands even higher projects from the eastern wall. Both rise from the lower terrace in vertical walls, the sides of true rifts, which formed as the level of the lava sank.

We estimated the depth of the pit below the upper terrace to be at least four hundred feet. It were better to say we guessed, for we had no scale for comparison. The depth was very impressive as one stood near the edge of the vertical cliff and looked down, half shrinking with the feeling that the foundations might be melting. Such a height is nothing on a solid mountain, but anything may dissolve in a volcano, one feels, and it would be unpleasant, most unpleasant, to be roasted or boiled in lava, if perchance one were not killed by the fall.

After photographing the sulphurous scene from the height of the crater rim we proceeded to where the gap on the west gave access to the upper terrace, across which we headed for the pit. Combe, followed by Bowen, held off southward, while I with Solomon went more directly toward the center of activity. We arrived at a

projecting angle of the cliff where I afterward saw that the edge overhangs.

Going as near the edge as I dared—I had a feeling of uncertainty regarding underpinnings—I stood, turning from the deep pit to look out over the steaming lava field where spurts of flame or lava rose. Solomon stood close beside me. Suddenly, as of the rainbow at Victoria Falls, he whispered, "It is fire!" His face expressed the utmost astonishment. I had told him the rock would be very hot and run like water, but it passed his comprehension till he saw it. All along the face of the cliff between us and the island little jets of molten rock were issuing, flowing down the face, congealing, and dropping like cinders into the pit. Solomon's expression was a study. It grew a bit anxious when I described the hot mass under the terrace from which these driblets were oozing and said we would go down to walk over the crust; but he stayed by me.

Presently we joined the others at the far end of the upper terrace. From it the pit, the lava cascade, and all the lower terrace can be studied. Combe and I set up our cameras, while Bowen examined the field with his field glasses. But a strong wind was blowing over the rim down upon us. "It is the down current produced by the rising current of hot air out yonder," I reasoned, paying little attention to the clouds gathering in the south. In that direction lies the higher volcano, Nina Gongo, which

had been rolling out huge volumes of steam all the morning.

The light for photography was gone before we could get all we wanted. We had to fold up our tripods unsatisfied, and we turned our steps toward the large fire fountain. I had some nickels in my pocket to stick into hot lava for paper weights.

North of our approach to the pit the surface slopes from the upper to the lower terrace, much as a glacier bends over a cliff. It is crevassed in a similar manner. Steam issues from the crevasses, but they are not very deep and are easily crossed on bridges. Being more familiar with that kind of going than my companions, I went down ahead close to the lava but was stopped by a regular *Bergschrund*. Though certainly not impassable, it required study.

As I looked a wrack of cloud was drawn down over the crater wall, tossed, torn, and dissolved over the lava. As it whirled and eddied the thought crossed my mind that at any moment fog and steam and sulphur fumes might begin a dance of death upon that floor. Beyond the *Bergschrund* lay a chance no man could measure. To walk over the lava involves little risk; it has repeatedly been done here and elsewhere. But suffocation in sulphurous steam is a hazard to be avoided. Eager as Bowen and I were to reach the fire fountain, we turned back.

We went out on a long promontory of the upper terrace, from which we could best see the fountains

and where Bowen collected sulphur. Then we sought shelter from the wind and lunched in a warm nook over a crack. We took our time; it was only an hour's walk to camp.

When we again climbed to the crest of the outer rim the aspect of the scene was serious. The storm no longer threatened, it was upon us, and we were fully exposed to it on that bare cone.

The scene was magnificent. A great black cloud swept up from the southwest, blue-black like Japanese bronze. Flashes of lightning lit it up and thunder rolled, reverberating. The lower edge was fringed with twisting shreds. It came swiftly.

I set up my camera to catch it, while Combe and Bowen hurried on to collect rock specimens. Solomon and a porter stayed with me. I put on a heavy black waterproof such as the police wear in Paris. Solomon had a mackintosh that I had discarded; but the porter was half naked.

They struck us before I could fold up the camera—rain and hail. The hail stung. The porter cringed but he did not run. Not until the pack was tied up in its orange-colored canvas and balanced on his head did he start. Then he went like a deer. I followed. Solomon stayed to fasten his sandals.

We skirted the steep, rough slope. The agility of the porter was beautiful to watch as he picked his footing swiftly, and what a color study he made! tones of brown

and blue-black under his bright burden against the gray distance! The hail bounded off his bare muscles.

After waiting till Solomon caught up, I too ran. The tumult of the storm, the wild setting of the scene, the waters cascading down channels that had been dry a few moments before, all exhilarated me. I shouted as I jumped a brook.

We soon joined the party where the other porters were crouching in the first bushes, and went on toward camp. We had gone some distance; in twenty minutes we should be in our tents with hot tea and dry clothes, when the six negroes stopped. They all talked at once, while one gesticulated wildly and pointed south along the mountain slope. They seemed to have lost their heads. Suddenly the one who had been pointing south started in that direction and the others followed. We protested, but they paid no heed. We got out of Solomon the explanation that we were in a wrong ravine and must skirt the mountain to the right one. Now nothing is easier than to miss the head of a valley. The storm might have confused us. Though still protesting, we followed them.

The succeeding hours showed what the African darky is without leadership. Elephant trails were numerous; our lost guides followed them hither and thither, raising our hopes when they turned down the mountain or dashing them when they continued southward. We were in the forest where there was no outlook. It still rained.

The aneroid showed we were a thousand feet above the level of the camp. My patience gave out finally and, summoning my little knowledge of Swahili, I ordered the best of the negroes to *kwenda cheeny*, go down, go down. He reluctantly obeyed and, by insisting on *kwenda cheeny* at every possible turn, I gradually forced him down. The party followed. In the course of another hour we struck the trail of yesterday and, returning some three miles north, climbed back to camp four hours after we should have reached it on the same ravine we had left.

Wet and weary I did not hesitate to accept Combe's prescription which he poured out from a bottle marked "Scotch." It worked well and a good night's rest fitted us to return easily to our starting point, Lulenga Mission.

XII

Parc Nacional Albert

LULENGA and the Fathers have begun to recede in the procession of memories that is constantly lengthening. One wants to hold them firmly in mind, the two disinterested, kindly péres and the beautiful scenes in which their field of labor lies. Those who wish to know it more intimately through the eyes of one to whom it is the shrine of the deepest experiences should turn to the pages of "Carl Akeley's Africa."

We were reluctant to motor to Rutshuru, though the walk of twenty miles promised to be hot and uninteresting. I for my part resent the appearance of the motor in untouched Africa, as this so recently was. But the Belgian authorities have reason when they forbid native porterage where a truck can be used, and the days of that service are numbered.

As we rolled along on the raised road through a swamp our driver told an amusing story of a recent experience with the *ancien régime*. "*Je passai par ici à dix heures du soir et Madame Hippo promenait avec son petit toto.*" She refused, he said, to leave the road and kept just in front of him at about three kilometers an hour, while the little one ran here and there across the road, trying

to hide in her shadow. She kept on for several kilometers, when he met another car and she was caught between the lights. Blinded, she pivoted about, charged a few steps and backed up, and finally dove off the road with her *toto*.

What a symbol of Africa, blindly stumbling in the glare of western civilization!

We have been courteously received by the young Belgian representative at Rutshuru and entertained at tea by his wife, a dainty suggestion of French refinement as pleasing as it is odd in this environment. We are comfortably housed in an almost palatial rest house shaded by fine trees. Seventy porters are promised for tomorrow and we will leave here on foot, turning eastward along the northern base of the Mfumbiro volcanoes toward Uganda.

"Here," said Combe pointing to the map, "we will stop two days and I will show you the most beautiful panorama of lakes—nothing like it!" We were talking at Lulenga of the other Mfumbiro volcanoes. Combe was reveling in the prospect of revisiting the scenes that had delighted him and eager to show them to Bowen and myself. Now we, too, have seen this wonderland which will soon take its place in the hearts of nature lovers.

Garden and wilderness touch for forty miles along the northern slope of the volcanoes, from Nyamlagira east to Muhavura. The populous garden runs down into wide spaces between innumerable cinder cones. The forested

MUHAVURA. THE EASTERN VOLCANO OF THE MFUMBIRO CHAIN. LOOKING SOUTHWEST.

wilderness, the home of the wild buffalo and gorilla, runs up to the bare crags of the fascinating peaks.

The heat of Nyamlagira's fires we have felt. The steam clouds of Nina Gongo we have watched rolling up to merge in tropical cumuli. Mikeno, the spike-topped, and broad Karisimbi have appeared capped with gleaming snow, changed to violet heights as the morning wore on, and later veiled themselves darkly in their flashing mantle in whose folds the thunder rolls. Five-toothed Sabinio has tempted us to scale its pinnacles. Little Gahenga and the great cone of Muhavura have played hide and seek in drifting mists and cloud girdles till we despaired of catching them in our photographs.

Aligned along an east-west fissure these are great monuments and great sphynxlike riddles also. Why does the range not run north and south in the arc of the western rift? Why, during the past million years or so, have subterranean forces of some sort successively built up the older masses, Sabinio and Mikeno, and later Muhavura and Karisimbi? Why are they active even now in Nina Gongo and Nyamlagira beyond the western end of the older line? What are these lavas and how and why do they differ, among themselves or from others, in chemical and mineralogical composition? But here I am getting over into the field where Bowen and Combe are experts. I had better watch my step.

Lava flows of various kinds and ages have spread from the bases of the great volcanoes and also from many,

many minor vents that dot the lower land. The little eruptions were often explosive and built cinder cones, which are commonly cultivated because the soil is loose and, as Solomon tells me, it is easier to handle a hoe on the steep slope. You don't have to lift it so high. The low table-lands of the lava flows and the flats between them are pastures, where herds of wide-horned cattle graze. Villages are numerous and so are groves of vegetable bananas or of those used to make beer.

From the zone of maize and bananas up to the bare heights of the volcanic summits vegetation ranges in kind and color, through bush, forest, and bamboo to giant heather. Between four and twelve thousand feet above sea, soil, moisture, and temperature favor a great variety of plants, and those that flourish in the cooler and wetter altitudes are isolated by the heated plain around them. The gorilla is a dweller in this island and is dependent for his preservation, not only on protection against guns, but quite as vitally upon perpetuation of the forest shades he inhabits and the succulent plants on which he feeds. Were I a gorilla gifted with foresight for my race, I would view the encroachment of the natives upon my forest, the grazing of cattle in my favorite celery patches, the cutting of trails, the coming of tourists, with grave apprehension. I would pray that the Parc Nacional Albert might really be kept for me and mine. "We want so little. They have so much."

The native and the gorilla have not been dangerous to one another. They have not competed seriously for habitat or food and neither has had any other essential want. The coming of the inquisitive, destructive white changes the outlook. To reach the peaks he will open trails or even roads. To build bridges and houses he will cut trees. To get water he will tap mountain streams. With matches and cigarettes he will spread fire. The privacy of the primeval sanctuary will be broken down and with it will go the great near-man. We would be sorry when too late.

The Parc Nacional Albert and the British park that is to be established[1] adjoining it, embrace the gorilla's home. His survival in it depends upon the cooperation of international authorities held by public opinion sternly to the preservation inviolate of that limited area.

[1] This park was established in February, 1930.

XIII

A Tale of Rivers

THE two lakes to which Combe so eagerly directed our steps, Mutanda and Buleru, lie at the sources of the Rutshuru River, which flows to Lake Edward, Lake Albert, and the Nile. They are the very headwaters of that mysterious stream and its mystery extends to them in their hiding place behind the great volcanoes and beneath the escarpment of the Western rift valley.

For our first sight of each of them Combe led us on an excursion to the summit of a high ridge and, spreading his long arms, expressed in pantomime the panoramic character of the view. The blue waters stretch away in long narrow valleys between steep grassy spurs to recesses in the mountain slopes. They spread as the fingers of a hand, and they are valleys ponded by obstructing lava flows. Long before old Sabinio began to be built up, even before the subterranean forces had disturbed the levels of the plateau, the Rutshuru river flowed in the sinuous course it now follows toward the northwest. Like every other river it extended its head streams as antennæ as far as it could, feeling for soft or shattered layers of rock in which to sink its grip; and this searching was stimu-

lated where slopes became steeper as the surface warped in forming the Western rift valley.

Lakes Mutanda and Buleru occupy the channels the Rutshuru then deepened, and the ravines that feed them are sunk in the slope which developed between two areas that rose unequally during the warping. An eastern area rose somewhat higher; an area where the garden now lies at the foot of the volcanoes lagged behind; but there were as yet no volcanoes.

The slope connecting the higher and lower lands steepened as the difference of elevation increased. Here and there the rocks were torn apart and cliffs appeared. Rifting had begun and it developed somewhat, but not conspicuously. The warped slope is much more extended than any precipitous escarpment.

The slope is nevertheless the eastern side of the Western rift valley, an imposing declivity two thousand feet high that impresses all observers with its grandeur.

Presently, as geologists reckon time, though after thousands of years, during which the Rutshuru had searched the slope and established deep channels, Sabinio and Muhavura were born of the earth. A lava stream from the latter entered the Buleru branch and dammed it. Another from a foothill vent flowed across the Mutanda branch and ponded it. The waters of the inflowing brooks rose behind the lava dams, and thus were formed the lakes that delight us.

Reading this story in the landscape was part of my task, but so far as the lakes were concerned I had been anticipated by Combe, who knew every lava flow by its first name. He had surveyed and named them. He also knew what I did not then realize, that the Rutshuru had originally been tributary to the Congo. The waters now flow from Lake Mutanda down the old channel to the depression which is Lake Edward. Their diversion to the Nile is a result of the formation of that basin and of the Lake Albert trough.

The waters of Lake Buleru have been turned into another and more extraordinary course, though also to the Nile. Held up to a relatively high level by the lava dam, they cross a divide toward the southwest and leap three hundred feet into Lake Luhondo whence, cascading still, they flow south. Turning southeast they run against the original slope of the land, wander aimlessly in wide marshes, reach the swampy Kagera that flows north for many miles to within a few miles of Lake Buleru, and there, hesitating in a papyrus swamp between joining Lake Edward and joining Lake Victoria, they go by one course or the other to the Nile.

We have climbed the escarpment east of the rift valley, leaving behind the comfortable rest camp called Chahafi and the potatoes, onions, tomatoes, and strawberries growing in the garden there. Your English official,

habituated to doing himself well, sees to it that the caretaker plants and tills.

I shall long remember Chahafi for its view of Muhavura, the view from the height of a sharp ridge over the long green, bush-grown slope of lava to the vast violet cone. I absorbed it as I sketched it that last afternoon, only yesterday.

From this camp, Bunyagi, on the ridge the view is all-embracing. The volcanic chain from Muhavura to Nyamlagira is all in sight and this evening we see the glow on the cloud above the latter's fires. Beyond Nyamlagira is the far range, very faint in the distance, which is described as the western escarpment of the rift valley. Fancy plays rather wildly with these accents of the plateau, exaggerating them to the height of great walls bounding a chasm. Fine imposing features they are in themselves, arduous to climb; but they do not wall this wide valley, they are not continuous for great distances, they merge into gentler slopes, and in the general landscape appear what they are: individual breaks of widely warped surfaces.

Leaving Bunyagi in the morning we walked several miles along the flat-topped ridge, past swamps and groves of mountain bamboo, the habitat of a small mountain elephant, whose tracks were every-where. They may have been driven off by our porters who had preceded us by half an hour. I wish I had gone ahead with the porters.

We came down to Lake Bunyonyi which, like Mutanda and Buleru, is a closed river valley, crossed it in dugouts, and are now at Kabale, at the end of the road that connects with Entebbe and the great world. We are thus once more in touch with civilization as represented by Indian shopkeepers, motor roads of a sort, and an English district commissioner. On the table of the D. C., Mr. Philipps, with whom we lunched, are English and French magazines of a serious kind. He talks understandingly of France, Italy, Roumania, Syria, Palestine, and also of current national problems. He administers British rule over a large mountainous area that is generally known as "darkest Africa." He knows every village, has safaried over all the trails, understands his people, and speaks their language. He considers their lot a happy one, though they wear only a greasy, untanned calfskin and live in grass huts with goats and chickens. "They work hard in the fields from morning to night. They are merry and contented. What more should they want?"

Kabale is practically the end of that section of this journey which began at Kigoma. Our objective up to this time has been the study of the volcanic wonderland. Here we adjust our outfit for somewhat more difficult conditions. We have come through a densely populated, well administered region, where good trails and rest-houses made the marches easy. Going north from here to Lake Edward, Ruwenzori, and Lake Albert we shall lack these advantages. It is pleasant to think, however,

Ferry on Lake Bunyonyi, Uganda.

that we shall have campfires. They have not been possible because there is no wood where we have been. They will be not only possible but necessary where we are going, for there lions roam at night.

Tomorrow, October tenth, we go on to Mbarara. In six weeks I shall reach Entebbe, the headquarters of the Uganda Survey, and this bit of work in the less accessible part of Africa will be accomplished. There will remain the study of the Eastern rift valley in Kenya and I hope to get into the great game reserve where domesticated lions pose for the movie camera. Perhaps they will favor me.

XIV

Ruwenzori

Once more we are back in the Western rift valley, if so simple a phrase can describe it. It has widened and in the middle of it stands Ruwenzori, a mighty giant, Heavy clouds enshround her, darkly contrasting with the golden light of the late afternoon reflected from distant Lake Edward. Lightning flashes and distant thunder rolls. It is snowing, no doubt, on the great mountain, whose white crest we hope to see clear at dawn tomorrow. It will be great good fortune if we do. Combe has camped here five times without being favored. The spirits of the mountain are jealous spirits. They veil Ruwenzori in a vibrating tissue of light rays in the dry season, and in the wet they turban her with thunder clouds. Her genii guard her well.

This is the camp called Kichwamba, seventy-two miles west of Mbarara, and today is October eleventh. We motored from Kabale and could have continued on the highway to Kampala and Entebbe. Bowen has done so in order to visit other volcanoes, but Combe and I have turned westward to see Ruwenzori and Lake Edward. A very fair road exists to this point and we reached it

by lorry at noon today. We drove across a rolling plain, a country of flat hills, a very green grassy country where many long-horned cattle graze. We crossed and followed winding rivers that we did not see for the plumed papyrus that covers them. They are sluggish streams now flowing unwillingly to Lake Victoria instead of freely to the Congo, as they used to do. The land has tilted and the rivers now run toward their former heads. Forests, the finest I have seen in Africa, survive in the western part of the plain. They are composed of strong, wide-branching hardwoods, under whose canopy are caverns of shade. The plain ends at the base of a high ridge, which extends many miles north and south and which is the eastern rim of the Lake Edward rift valley. Usually a rift valley traverses a plateau, but here only a ridge separates the lowland of the rift valley from the very different and somewhat higher lowland of the Mbarara plains.

The very steep slope from the ridge toward the west forces the road to take several pinched hairpin turns that were much too sharp for our Chevrolet trucks. The Indian (Hindu) drivers had to back and fill twice. They did it quite skillfully, but the one with whom I was riding needed the help of my good fairy. He had backed uphill and had the truck headed across the road toward the high grass that concealed the precipitous drop. When he let his brakes go the truck got away from him. His first grab at the emergency brake missed it and the second one was too late. The front wheels and the

weight of the engine were over the bank. Yet as he jerked the lever back the car stopped and I should have said, "Bravo!" if he could have understood. But when I looked under the car I saw that our front wheel was stopped by a big rock, and I thanked my good fairy instead.

We would have gone about four hundred feet into a very interesting hole, an explosion crater. All along this rift there are hollows, several hundred feet deep and a thousand feet more or less in diameter, that have been blown out by volcanic explosions. The sides are actually vertical in places. We stopped just above such a place. Now if a lion got you, you couldn't complain, but an explosion crater! with a Hindu and a Chev! No, I thank you!

When futile efforts had proved that the truck could not get back by its own power a boy was sent on to recall the other truck and I walked on to camp. I found Combe sitting down to tea.

"You are late," he said.

Kichwamba is a delightful camp. It is new for one thing, the old camp having been burned because it became infested with the spirillum fever tick. The site is a beautiful one. I am sitting under the extension of the thick thatched roof in the veranda of cane and matting. The afternoon sun throws a violet haze over the wide valley that extends from our feet to Ruwenzori. All the hills and plains are green, like the verdure of an English countryside in May, and I am tempted to go strolling.

I shall not stray far from a native path if I do, for yonder lawn grass is fifteen feet high.

When the sun rose this morning the eastern sky was clear, but in the west clouds covered the upper half of Ruwenzori. We could not see the snows. Long lines of mist lay along the valley and the play of light was exquisite as they drifted, rose, melted, and formed again against the mountain's dark silhouette. Gradually its serrate crest appeared here and there, revealing the character but not the complete form of the arched profile, sixty miles in length; nor did the clouds lift sufficiently to show us the full height of 13,000 feet above the valley. Nevertheless, I took a photograph, for who knows when the genii will again be so generous?

The relative altitudes above sea are Kichwamba 4,200 feet, Lake George 3,020 feet, and Ruwenzori 16,794 feet. Tomorrow we go down to the plain and must look up more directly, but a mountain is often most majestic from an opposite height such as this.

This morning we went out to examine and photograph the explosion craters, of which there are many hereabouts. Many of them contain lakes, deep-set sky mirrors framed in green. Pink cliffs show the strata of volcanic mud that form the hills, and at first one simply assumes that the muds were erupted from these identical vents. But they were not. The story is not so simple. It took a great many eruptions extending over hundreds or thousands of years to pile up the strata. Only the very

last explosions are represented by these craters, which probably have but little connection with the earlier centers.

I should like to have seen one of these explosions, not a prolonged series of paroxysms, but a simple shot projected a mile or two into the sky, a column of steam shining in the sun and drifting away on the upper wind.

Combe is a very unusual photographer. He knows every make of camera, plates, and other photographic devices. He has purchased the best without regard to cost. He would wait for weeks for a favorable light, and having found a desirable view, he will go back again and again to get it as he wants it. But his ideas of composition and mine differ. He delights in panoramas, in completely comprehensive pictures. I seek foregrounds and setting for my objectives. It follows that we soon separate when out photographing.

This morning I left him on a commanding cliff from which I followed a track down into one of the crater bowls. It contained a lovely lake overhung with trees. Tangent to its circle was another also holding a lake at a level some two hundred feet lower. Oddly enough no stream cascades from the upper to the lower lake. The bowl has never been full. I loitered at my pleasure, accompanied always by my silent Solomon. I do enjoy these hours.

We have come down from the pretty camp at Kichwamba and are pitched for the night on the flat above

the wide Kisinger channel that connects Lake George with Lake Edward. As we ferried across in canoes this noon a hippo disported himself a short distance away. We expected to see an abundance of game here, but the past season has been dry and the game is said to have migrated.

In nine miles we have come from an area that is densely populated into wide plains that have been completely depopulated. Not many years ago cattle-herding natives covered this region, but they have gone. The tsetse fly reigns.

The condition is similar to that which exists in the Panama Canal zone. It is possible there to destroy the mosquito within the narrow strip necessary for the working of the canal, and no one is allowed to live outside of it. Here the fly can be kept away from the established camping places by clearing away the "bush" in which it harbors. No one is allowed to live elsewhere in the area. Moreover, the fly can become infectious for sleeping sickness only by biting a human being who has the disease. He therefore becomes harmless when an area has been "closed" for a length of time. He continues to be fatal for cattle, however, since there is always game to keep up the infection of that disease.

We had a lively afternoon. I went a little way from camp to sketch a foreground for Ruwenzori, assuming that she might show up at least partially just before sunset, as she has for the past two evenings. One of these

queer rigid euphorbias engaged my attention till I was diverted by a deep roll of thunder. The daily shower was due, but a glance showed me this was no shower. I got back to camp just in time. Sheets of rain drove slantingly across the plain, our tents tugged at their ropes, and the gusts threatened to flatten out the frail bamboo resthouse where Combe and I were sitting at tea. Combe's eight boys and Solomon ran to secure the tents regardless of the complete ducking they got. Only one clever chap used his brain to save his shirt. He ran into my tent and hung on to the pole to hold it down. I found him there when I dashed across for my raincoat and, though I knew the tent could be blown right off the pole, I did not order him out.

This date, October thirteenth, has been a critical one on our schedule. We had to be here today, without fail, for the seventy porters we require had to come from the mountain outside the depopulated area. Two months ago Combe wrote to the district officer; he informed the native king; the king informed the tribal chiefs; they instructed the village sub-chiefs, and they must select the porters, many of whom will come from as far as three days' march. They must bring food, there being none here for them, and they would not wait if we were late. But we are here and the sub-chief of the villagers who run the ferry tells us the porters have begun to arrive. It is one of the odd conditions arising from native custom that none of the abundant food to be had

east of the channel can be brought over to this side, nor can porters. The channel is an ancient boundary between native kingdoms. Different customs and different languages separate the people. It is the English policy in the Protectorate of Uganda to respect and uphold the native governments while training the chiefs in English ways. So the old system persists.

As old "Stoney Face," the mummified darky who has been Combe's cook for eight years, served the *filet de poisson* fresh out of the channel, he checked a moment, listened, and said something to Combe. "He says he hears lions talking, man and woman," said Combe. We went out to listen, but they did not continue. Combe then regaled me over the fish with tales of lions breaking into huts or ripping up tents and dragging out a victim. "There are no doubt plenty of them here," he said. I knew that he was "pulling my leg," a favorite form of humor with him, but also that there was some reality in his statements, for he had had firewood brought to keep lions away. I ate my fish with relish, however, and asked for details. Did lions prefer negro or white? Did they take a man by the hand or drag him out by the feet? Had he ever seen a man carried away or perhaps been carried off himself? We laughed over it and let the subject drop. When we went to our separate tents I was, nevertheless, a little in doubt what to do. The camp was dark. Dr. Teale had advised me to follow his habit of keeping a lantern burning in front of the tent as a pre-

caution, but it would certainly annoy Combe. I put the light out and went to sleep as usual.

We have seen neither lions nor lions' track today, but other game has not been entirely absent. Mama and Toto Hippo had taken a morning stroll on the trail; a family of three water buck looked at us proudly and unconcernedly as we passed within two hundred yards; a single buffalo grazed quietly while we watched him from about the same distance. He was a big fellow, very much like a blue-gray water buffalo of the East.

In a small lake we passed, a hippo came up twice close to the shore, inviting us to come and photograph his ugly snout; but when we went down to the water's edge he swam two hundred yards under water to come up and grin at us—if a hippo can grin. While we were fooling with him and Combe was shooting a goose for dinner the porters went ahead of us and drove five elephants off the trail. Too bad! But it is an interesting country.

Eighteen miles and a muddy path. Following Combe hour after hour, watching his powerful legs push his two hundred and twenty pounds over hill and dale, I am impressed with the fact that he is a big man. The sun has scarcely risen on our march before the dark sweat stain spreads from neck to knee. If he really melted, the track would become impassible. I estimate he loses a pound a mile, but he makes it up each evening after his bath.

I forgot to mention that we crossed the equator today, close to the little salt lake. Let it represent the sea and the hippo will do for an African Neptune. As Solomon had never crossed the equator before, he deserved initiation. Approaching the lake, I said to him, "Want a drink?" Of course he was thirsty. While I photographed he made his way through the reeds and came back spitting out bitter water, but laughing heartily at the joke. Wild ducks flew up, disturbing the perfect reflection.

"Your angel nearly went to heaven ahead of time," growled Combe, who was about to snap his shutter.

Well, we are across the Mbuku. There has been no delay, no porter has been washed away, not a load has been wet. We are still moving according to schedule.

All this is cause for congratulation. This being the wet season, flooded rivers are among the mischances to be anticipated. The Mbuku has been Combe's chief bugaboo in this part of our trip, partly as a real anxiety, partly as an opportunity for teasing me. I doubt if he has had much satisfaction out of the latter, however.

The Mbuku rises in a glacial amphitheater on the eastern slope of Kiyanua, a crest of Ruwenzori on which the altitudes range above fifteen thousand feet. Mt. Stanley (16,325) and Margherita (16,794), the highest peaks, lie a little farther west. The river falls some seven thousand feet in the first six miles and five thousand feet more in the next fifteen miles of its course to the plains of Lake

George, where it divides and becomes a braided stream. It is there that the track crosses it.

Yesterday we waded a smaller river whose swollen current tested our footing severely, and we approached the Mbuko today with anticipation of difficulty. I, for instance, had put my camera, wrist watch, etc., in waterproof places. But the snows and thunderstorms of these last few days had not raised it to full flood. "A little water," said the sub-chief who met us with his experienced villagers. They serve as guides or ferrymen on foot to help porters across. They even had a mat slung on poles on which I was carried across by six men; what's the use of getting wet? Combe, disdaining any help, strode into the current where it ran high, and I watched with interest as he steadied himself on his heavy walking stick. His compressed lips expressed his effort. I should have been carried off my feet.

To pass our seventy porters with their loads balanced on their heads the villagers formed a line and stood in the rushing water ready to give a hand where needed. Some big fellows got nervous, stumbled, and grabbed at anything. A little manikin of an askari, one of Combe's retinue, carried his head with its red fez as steadily as if on parade, like a real soldier; and Solomon, careless of the staff which all others used, came across balancing on the slippery footing like a tightrope dancer. Our half dozen chickens, who ride luxuriously in a huge bamboo coop, got excited in midstream and added their alarms to the shouts and

laughter of the natives. It was a most picturesque and colorful episode—thirty or forty dark figures struggling through the splashing waters, behind them the tall elephant grass and the cumuli of a tropical noon.

It is October seventeenth and we are making progress.

The daily thunderstorm is gathering fully an hour late because the morning was overcast and showery. When, lantern in hand, I came out of my tent and sat down with Combe to breakfast there was an orange streak in the east. It was all we saw of the sun until near noon. In the meantime we have come eleven miles on a track where elephants had skated and where we slipped at each step in the deep black mud; camp has been pitched and we have had tea. Then the sun came out blazing hot and got busy storing up the electricity and moisture for the afternoon performance. There! There come the first big drops pattering on the tent.

Our camp is about seventeen miles south by west from Fort Portal, the administrative headquarters of western Uganda. There is a colony of British officials there, but we shall see little of them. To go to Fort Portal for twenty-four hours means social occasions with ladies. You don't catch Combe with that kind of bait.

"Bwana!" A boy sticks his head in between the tent flaps and hands me a letter. It was received at Entebbe October twelfth, forwarded by Wayland to the D.C.

at Fort Portal, and by him by special motor bike to our camp. That is British efficiency.

The white teeth of Ruwenzori are showing in the failing light. They are gone in the darkness. But I have seen them. Yesterday I glimpsed them less clearly. Alone with Solomon I followed the trail of several buffaloes through the deep grass to a summit that commanded the upper Hima valley and the stupendous gorge of the Mbuku. We watched the clouds shift till we had to go quickly. Leopards sometimes prowl early.

The great central mass of Ruwenzori is a very old, very deeply carved mountain mass. It is quite inaccessible at this season as the track lies in and across torrential streams. But from that mass a long nose extends toward Lake Albert with a general elevation of eight to ten thousand feet. It is in line with Lake Albert, which is odd, to say the least, for the movements of the two blocks of the earth's crust appear to be contradictory—one up, forming the Nose, the other down, forming the trough of Lake Albert. It is deuced awkward for theorists to explain.

I had not hoped to do more than pass along the eastern base of the Nose, but Combe and Wayland have planned to have me circle it and cross it. We are to go along this, the eastern side to the end of the Nose, pass around it into the Semliki valley, and, after going southwest some four days' march, cross it at eight thousand feet back to this side. It is a unique opportunity, as Combe is the

only geologist who has done it, and it will give me an understanding of the relation of the mountain to the rift valley.

After returning to this side we shall proceed to Lake Albert, where the steamer *Samuel Baker* will call especially for us at an unfrequented point.

Sir Samuel Baker! It is inspiring to think of traversing his lake in a steamer named for him.

RUWENZORI—LAKE ALBERT

THE *map illustrates the peculiar relation of Mt. Ruwenzori to the trough of Lake Albert. The mountain is a dome-like uplift with a projecting nose which is bounded by faults. The Albert trough corresponds to a depressed section defined by faults on both sides. The escarpment along the southeastern side of Lake Albert corresponds to a sequence of short faults which succeed one another en echelon. The last one toward the southwest ends against the Nose of Ruwenzori at the Wasa angle. The relations of the subterranean blocks, whose movements have produced this superficial structure, present a difficult problem of rift mechanics.*

The Toro plateau formerly sloped westward and the rivers all flowed to the Congo. During the gradual uplift of Ruwenzori and the formation of the Albert trough the plateau has been tilted eastward and the rivers have been converted into papyrus swamps or actually turned back upstream. The Kafu thus flows away from its former lower section, the Nikusi.

Sketch map compiled from several sheets of the 1:250,000 *map of Uganda.*

0 10 20 30 40
Miles
CONGO PLATEAU
above 6500'
LAKE ALBERT
Nile R.
Kibero
2037
Kyso
30°
Kasenyi
Ntoroko Pt.
Semliki Valley
Kibuku
2100
Mucwini
TORO PLATEAU
5000
Kichwamba
Fort Portal
Bundibugyo
Bwamba
Mts. of the Moon
MT RUWENZORI
16800
Elephant
Chalets
to Kamolia
Katonga R.
Nabakazi R.
Route
LAKE GEORGE
TORO

XV

Around the Nose

It is seven thirty a. m. and Combe has gone on the motor lorry to the next camp, another Kichwamba, while I am waiting to follow him with a second load. I should have had the whole morning here to myself, but a Norwegian coffee planter has offered to help us out.

We have reached the edge of European settlement, which is pushing out upon the foothills of Ruwenzori wherever the altitude exceeds five thousand feet and as far as the road is extended. This Norwegian is typical, an active, hardy fellow, about thirty years old. He has started a coffee plantation and must wait three years for his first returns. In the meantime he has taken a job with the Public Works Department to build a few more miles of road southward beyond his place. We have seen many similarly situated. They are waiting all along the African frontier, from Nyasaland to the Sudan, for coffee to come into bearing. They probably know better than I what the market will take. Yet I wonder how secure is the future of a planter who has but one crop and that a crop whose price depends upon competing native or even Brazilian production. Is the stabilization of coffee values by the bankers who have loaned money to Brazil a

guaranty for African coffee growers? Or may they become the African tail that will wag the Brazilian dog? Or will the Japanese migration into Brazil introduce cheap efficient labor there to a degree that will enable Brazilian planters to undersell the African with his inefficient blacks? Or will some whim of preference for this or that flavor in the coffee decide for or against the African? It is an intricate, irridescent web and woof. And this young fellow stakes his future on it while he tents alone, a tame duck and a gramophone his only companions.

Kichwamba is a good name for a rest camp, apparently. In any case it is the name of two good camps, the one where we stayed southeast of Ruwenzori and this one, eight days' march from the former, northeast of the main mountain mass. This is the more elaborate, as one would expect within twelve miles of Fort Portal, the administrative center of northwestern Uganda. The central hut is large enough to take all our impedimenta "not wanted in cabin," which in our case means "not needed in tent." There is an extensive, hand-clipped lawn, on which our two-room tents are pitched. The boys' huts are so far away that they can chatter as they love to do without being called down for making such a *kelele*. It is necessary, however, for me to emphasize loudly the last syllable in Solo*mon*, when I call that cheerful, gregarious individual, and Combe takes it up from his tent in stentorian derision. A strong bamboo fence encloses the ample

spaces, which are shaded by well-known, delicate-leaved trees, the Australian wattle.

We arrived yesterday, completing the march up the wide valley along the eastern base of Ruwenzori. We have before us the trip around the northern end of the Nose and southwest along the other side to the Bwamba country, a little known section. Bwamba is little known because seldom visited. Only officials go there, since Ruwenzori lies across the route from the British side and the Belgian Congo bounds it in the unhealthy Semliki valley. We shall keep on the higher ground, the foothills of Ruwenzori.

This is our second day here and we have had a call from the provincial and district officers, who courteously drove out from Fort Portal. It was quite a novelty to see a handsome motor car drive up.

Our visitors told us how the Prince got lost in this vicinity during his recent visit. Coming from Lake Albert to a reception at Fort Portal, he attempted to ascend the escarpment by a track which, though indicated on the map, has been abandoned to elephant grass and buffalo. The Prince and his one white companion, following their blacks, struggled through the tangle till darkness obliged them to sit in the grass and rain until morning.

"The Prince seemed quite bucked up over it. He had never had a chance to get lost before." said the P.C., in whose experience such mishaps had no doubt been commonplace delays.

The talk turned to roads toward the Congo, beyond Fort Portal, which is now a terminus. There is a choice of routes, and a decision as to which will best serve British interests is not yet clear to the P.C. A road the Belgians are building eastward from Rutshuru, past the volcanoes toward Kabale, would follow the present tract and be the most direct, but in British territory it would meet with costly physical difficulties in ascending the high escarpment of the rift valley. Whereas, as Combe pointed out, a great natural route of travel runs from Lake Albert southward past Fort Portal along the eastern base of Ruwenzori and Lake Edward to Rutshuru, Lake Kivu, and Tanganyika. It is one of the future north-south highways and will one day be linked up in spite of the fact that it is crossed by international boundaries, arbitrarily established. Even the tsetse fly, which has depopulated the plains around Lake Edward, will be unable to prevail against the tourist. Where we have passed in safety, protected by clearings, others may do the same.

After our visitors left, Combe and I prepared to develop films, a complicated procedure when tenting in the tropics. Water comes on porters' heads from some swamp or water hole and, after being filtered through a sheet, is placed to cool in gasoline tins wrapped in wet blankets. After dinner, when he is ready, Combe orders all lights out, draws the flaps of his tent, and develops one roll, no more. A solemn half hour is spent in utter

darkness. Permission having been given by authority, light and life are renewed. Then we praise the Lord.

That is Combe's way. I, not having assumed that I could command darkness at my pleasure, have a small tent of black balloon cloth within which darkness reigns night and day. It is ample enough to cover a camp table and me, but not Combe. It is not ventilated, but I can spend several hours in it, occasionally emerging for a breath and to hand fixed negatives to Solomon to wash,

Solomon has become a connoisseur of negatives and shakes his head in sorrow over my failures. It pains me to hand him one that is scratched or out of focus or light struck. He knows. I feel that I have lost caste. He goes on patiently, deftly moving the films from tray to tray, his eye on the clock.

"That lot washed, Solomon?"

"Two minutes more, sir."

I know that two minutes will not make any difference, but I dare not stop Solomon with eighteen minutes washing, having told him twenty. I watch wearily. Solomon washes patiently. Only when the hand has moved past the mark does he pour fresh water over the negatives and hand them to me to be hung up.

We have used the interval here to cut down outfit by eliminating everything not needed on the stiffer trip ahead to the Bwamba country. We are ready and will be off in the morning.

THE WASA ANGLE. MEETING OF THE FAULT FACES—ALBERT RIFT (LEFT). RUWENZORI (RIGHT). LOOKING SOUTHWEST.

The path leads down the escarpment from the plateau to the plain south of Lake Albert, a drop of fifteen hundred feet. It will give me my first chance at the Albert rift and that at a very critical point, where the fault ends by abutting against the mountain block of Ruwenzori. At this point another fault separates the mountain from the plateau and the two faults bound three blocks, Ruwenzori, the Toro plateau, and Albert plain, which lie at or have risen to different altitudes. What are the mechanics of those movements?

Incidentally or causally the plateau east of Ruwenzori is dotted with explosion craters, similar to those we saw farther south. There are some two hundred of them here. They are not the foci of lava flows, many of them having burst up through the gneiss of the plateau, others through tuffs, but they probably indicate the former approach of lava to the surface.

This is Kibuku, a rest camp at the extreme northern end of Ruwenzori, only twenty-four hundred feet above sea. Several eminent geologists have been here, for here is a petroleum seep and possibly a future oil field. The seep, which we hunted up in a deep ravine (Combe leading with the rifle "for you never know what you may meet in these shady water courses") is merely a smell. But it is a real smell and indicates that the Kisegi beds, of Oligocene or Miocene age, which dip off the gneisses of Ruwenzori, do contain some oil.

When we had climbed fourteen hundred feet to a hilltop that commanded the view, I was strongly reminded of the San Joaquin Valley in California. Definite topographic features clearly indicate the structure beneath the plain.

This rest camp will soon be burned, as resthouses have to be from time to time. When Combe and I were drinking morning tea in its shade Solomon came to ask me, "You know that, sir?" On his hand lay a bloated, yellowish green object. "Spirillum tick," said Combe. We did not find any in the resthouse, but the kitchen hut had "plenty," as Solomon said. Being of nocturnal habit the tick is regarded as not dangerous by day and no one of our party sleeps except in a tent. But the tick and infected tsetse fly combine to make the Semliki valley unfit for habitation. The lowlands are closed.

Tomorrow we turn the Nose and enter the Bwamba country, where among other interests hot springs invite curiosity.

XVI

Bwamba

"We're doing a very foolish thing," said Combe as he pulled his leg out of the muck in a deep elephant track. "We've no business to be in this swamp without a gun."

"Quite so," I agreed heartily.

Camp was barely half a mile away across an open meadow, not ten minutes' walk apparently, but more nearly an hour's floundering in reality. From the foot of gray cliffs and a narrow belt of trees the gentle grassy slope reaches far out toward the Semliki river, covered here and there with palms and bushes that mark the course of a brook. It looks like a meadow in which to pluck violets and cowslips; but the grass is waist-deep or shoulder-high. It roots in black muck that quakes, and when Combe's great weight went through he came out a pretty sight to see. "Lord! What a mess I'm in! Did you ever see a man in such a mess!"

Where the ground was a little firmer tracks of buffalo and elephant were numerous and fresh. It was hard to say whether they had been there last night or within half an hour. Twice in the course of our walk I was reminded of the elephant house in the zoo by the char-

acteristic elephant smell. The native in front of me was cutting through a tangle of brush and thorny vines where one could not see five yards and could not have run one. We stepped out of it on to a frequented path. Was the big beast standing half asleep around the next clump?

From this meadow clouds of steam rise. Some of them are whiffs that melt into the air. Others are continuous and rise several hundred feet before they disappear. The meadow is dotted with boiling springs and the waters that flow through it are hot. Our barefooted negroes became very particular about their footing, and Combe will not soon forget the sensation of plunging one hand into a scalding pool while he wallowed in comparatively comfortable, cool muck.

We had started out to reach the source of the largest cloud of steam, "just over there." Yes. But we were forced to twist and turn, to skirt pools of boiling mud while we balanced on tussocks that rolled on the roots, to cut through thorns, and to follow his Lordship, the elephant, where he had trodden out the path.

At last we walked gingerly up a slope of sinter, stepping carefully between streams of boiling water, and came to the edge of a deep green pool bubbling within its crenulated margin of gray and orange-colored tufa. It would be a beautiful pool even in Yellowstone Park. Here it is unique and we do not know that any European has previously crossed the marsh to it, though the smaller

springs near the track have been visited by the occasional passers-by.

Ten-fifteen p.m. Bedtime! Y-e-e-s, but . . . ? One of my regrets up to the present has been that I have scarcely seen an elephant. Giraffes, a lion, buffaloes, hippos, antelopes; yes, I have seen them all at home though not too near; but no elephant showed up until last evening. It was just before sunset. A group of the porters stood looking intently and pointing from the hill on which we were camped to a black object in a distant meadow. It might have been a flat-topped bush, but presently it took a step, threw up its trunk, and shook its huge ears so that the sky reflections wavered across them. Then it stood a long time ruminating. Only the big ears waved. Then it moved ponderously, slowly toward us and passed under trees.

And now my hesitation about going to bed is due to the fact that two elephants are feeding about a hundred feet away and a herd is near by. They presumably are peaceable members of the community, but they might inadvertently walk over a tent.

As I was writing about the boiling springs I heard excited natives calling, "*Njojo, njojo,*" the native name for elephant. Going out, I found Combe in his pajamas with his heavy rifle and a dozen natives with spears gathered around him. Others were tooting horns and beating on sticks. We are about one hundred feet from

tall elephant grass in which My Lord is trampling and munching. We have listened to him for half an hour. He seems in no hurry to leave. He may decide to join the others who are on the other side of camp, and he may trip over a tent rope. I'd warn him if I could, but he will have to take his chance. Good night.

Oh, yes. We had a quiet night so far as I know. I turned my light low, but left it burning in case I wanted it to salute My Lord Elephant, having first had Solomon fill it. No foolish virgin I. That done I slept till daybreak.

This morning I went over the tracks of our visitor. Coming out of the tall elephant grass, he had passed within fifteen feet of a little tent occupied by Solomon and some of Combe's personal boys. He probably did not notice it until he had gone by them and got their wind. Then he had turned at right angles and stepped into the tall grass again. The boys, however, had not stayed; they ran shouting to Combe's tent. From there, where we had stood with lanterns and the rifle, it was eighty feet to the trampled grass where My Lord ruminated.

"To kill or not to kill? That's the question. Confound these little men! To crush; perchance be stung. Aye, there's the rub. They sting." He fed . . . "I wonder where Jumbina and the totos are. They might get into hot water." And he went.

We saw this morning where not one but several families had gathered above the hot springs about two

hundred yards from where we slept, and for miles along the track huge footprints showed how they had walked and slipped—danced, for ought I know. I could just see them cavorting down the track.

We are pursuing our route southwest with Ruwenzori's great mass on our left and the flats of the Semliki on our right. The altitude increases along our way as we ascend to habitable terraces. Kibuku is three days' march behind us. Last night we camped at that social resort of the elephants, the Hot Springs, and now we have come to Buyayu, a populous center at an elevation of four thousand feet. To reach it we came through an equatorial forest belt of fine trees, verdant undergrowth, and abundant life of monkeys and birds. The birds were heard rather than seen, and no one knew any of them except the hornbill who has a policeman's rattle in his

throat. The monkeys scampered through the tree tops and scolded us.

Here there are extensive native plantings of corn, cabbages, and bananas. There are many varieties of the latter, which are baked, boiled, eaten fresh, or made into beer, as the case may be. Rice is also grown. It is a perfect paradise for Combe, who knows as much about cooking as he does about rocks and delights in exercising his skill. His knowledge of culinary processes embraces English, Scotch, German, Italian, Greek, Indian, Malay, Chinese, and African cookery, and he not only knows but also practices. He regales me with fowl, fish, and mutton prepared by himself for cooking Uganda fashion, wrapped in banana leaves with onions, peppers, mushrooms, and all available spices.

He goes into the native gardens along our route and we have whatever the land affords. Tonight it was chicken, rice, and onions boiled together, followed by corn on the cob, and that by sliced bananas and pawpaws. He is certainly the prize caterer.

By the way, at our camp last night, twelve miles from the hot springs, we heard a great shouting, tooting, and banging. "Njojo in bananas" was the report. You can imagine what a herd of twenty or thirty elephants would do to a closely planted banana grove.

When you have reached the end of your tether stop. That is both logic and reason. We are stopping, having

Bwamba Boys Going Courting.
Poised Boulder, Zerengetti Plains.

stretched our tether to reach this end. We shall spend tomorrow at this place called Busalu and then turn back to cross Ruwenzori to Kichwamba near Fort Portal.

Busalu is a small village northwest of the main mass of Ruwenzori, in full view, clouds permitting, of Mt. Speke (16,080 feet) and the companion peaks, Mt. Emin and Mt. Gessi. That is the reason we are here.

Combe was here several years ago. He worked a month on the geology of the mountain and carried away a deep impression of the beauty of the snowy peaks behind the green plain and foothills. He has been as eager as a boy to show it to an appreciative spirit and jumped at the chance when I told him I had time available for this additional trip.

He has a very keen sense of the beauty of Nature in the mass. He walked miles this morning absorbed in watching for the snowy peaks of Ruwenzori that played hide and seek among the clouds. He has brought me here to see them—no light matter, as you might guess if you could see our safari of eighty-five porters whom he drives on day by day, often through rain and mud. Experienced officers travel but little at this, the rainy season, but it is the only time when the air ever becomes clear enough. He strides through the storm, with his purpose sustained by the hope that the great peaks will stand out for half an hour perhaps. Then he will photograph them.

"We knew the Bwana was crazy," say the porters watching me, "but this is the craziest stunt of all."

Why does he sit out there when his tent and the rest-house are close by? He's even taken a chair and planted himself beside his little black box! Crazy old Bwana!"

I am watching the floating clouds. A few moments ago Mt. Emin peeked out. Now the whole group is hidden behind the rising mist that filled the valley below. It is melting in the sun that already shines hot on my back.

Pompey and Jo, black as your hat, have just gone by. Jo toddles ahead, sober as a judge, dressed only in his birthday robes. Pompey has reached the dignity of a rag. He is proudly conscious of his estate and struts a bit. Moreover, he wields a knife at least half his own size and swings it energetically. Jo would be in danger were his skull not so thick that it would stand off any blow Pompey might chance to give it. They are on their way to the field where mother is already working with characteristic industry. Yes, here comes father—breech clout of turkey red, brass armlets shining, and spear in hand—alert for the business of the day. Oh, *homo sapiens!*

Their palatial home is in the foreground of the photo that I still hope to take. Its dome-like roof of grass hangs low over the gray walls of mud and the whole is nearly hidden by a fence of woven bamboo. It is a very strong, elastic fence, which only Njojo could trample down or Simba tear apart.

Combe has just inquired if he should send a runner to tell the mountains not to slip away before the clouds

clear off. Rank on rank of white mist has risen along the twelve-thousand-foot slope that faces us beyond the plain. Now one peak, then another has shown through them, but not yet have the three great ones appeared together. Nor did they, but I caught them separately.

We have returned five miles to Bundibugyo at the foot of the Bwamba pass and are resting on our oars, so to speak. The extra days which Combe wisely allowed for possible delays have not been needed and have now accumulated on our hands. We have thirteen days in which to make six easy marches. Tomorrow we shall rest here, still at the western base of Ruwenzori. Then we shall cross the mountain, taking two days to ascend five thousand feet and drop down three thousand. That brings us back to Kichwamba rest camp, within reach of Fort Portal, where we shall remain four days. Some interesting excursions are possible, but I have a great accumulation of photographs to develop and shall spend many hours in my tent of black balloon cloth.

On leaving Kichwamba we shall descend again to the flat floor of the Lake Albert valley, where the scenic attractions are bamboo grass, buffaloes, elephants, and tsetse flies. We are to be at Ntoroko Point at the south end of Lake Albert on November ninth, to be called for between eight p. m and midnight by the steamer *Sir Samuel Baker*. That is the engagement we cannot afford to miss, for the boat would not return for a fortnight.

I may have seen various things by the time we get aboard the steamer. Combe suggests that hippos may be tame and numerous at Ntoroko, for instance, as no one lives there or ever goes there. Crocodiles also abound.

This is weekly market day at Bundibugyo. It brings the people of Bwamba from miles around, from the valley and from the mountain. They bring their produce on their backs, the women do, and squat beside it, exchanging family news I presume, as mothers and grandmothers have ever since Eve shook her head over her grandchildren.

They wear their best, especially the young matrons. Here is one who may be twenty or less. She is at the height of physical vigor. Her dark chestnut skin lies smoothly over the powerful muscles of her thighs and body. Her broad face expresses both good nature and good spirits as, arms akimbo, she chats laughingly with another. She has a slight advantage over the latter, however, for she wears two heavy brass collars to the other's one, has more ornaments stuck through her upper lip, and sports an ampler strip of bark cloth fore and aft, suspended from her girdle. Her air as she chats gaily with her friend has all the poise of a lady at an afternoon tea who knows that she is perfectly dressed for the occasion.

The shriveled forms of the old women tell of much childbearing—a necessity where a majority of the infants die—and their listless look expresses the monotony of their lives. The old men are livelier.

The market opened with a bit of pantomime. Some twenty or more young men came across the open space before the chief's house carrying shields and brandishing spears. They executed a brief war dance, altogether too brief for my purposes, since I had run for my camera. Later, when they had disbanded, I saw them mingling with the crowd, expecting the admiring looks they got from certain quarters.

Four young fellows there were, who wore feathers in their woolly topknots and in place of the usual scanty breech clout had a blanket of orange and yellow stripes hanging to their knees between their legs. Combe explained that the feathers indicated their desire or purpose to capture a girl, a warning or an invitation as it might be taken.

I strolled for an hour or more silently through the company, often unnoticed, often courteously greeted with "*Jambo sana, Bwana,*" in Swahili or with the native equivalent. If I leveled my kodak there would be screams, dodging, and laughter. They are a kindly people, the Bwamba.

We got away soon after day break this morning, as usual, and from our camp halfway up the Nose of Ruwenzori we can now look down on Bundibugyo (I love that name) and the far-reaching plain of the Semliki. We are on the Bwamba pass trail, the direct route to Fort Portal. The height of the pass is eight thousand feet. We

are camped at fifty-six hundred on a narrow spur which commands a fine outlook over the Semliki valley and along the western slope.

I am interrupted by Combe. "Say, come here! You are missing something." I join him to look at the view. A late afternoon shower has just passed. Rain is still falling, but the cloud that enshrouded us is passing. It has cleared from the rich green slopes above us. They are brilliant in the sinking sunlight, but the spurs reach down into masses of mist that fill the valleys below us. There the winds are tearing them to pieces, making rags of cloud, and whirling them now here, now there, now up in long spirals, ghost clouds.

"Isn't it beautiful! Did you ever see anything like it?"

"No, never," I answered.

We are over the Bwamba pass.

I have never been quite sure to what extent Combe was telling the truth or was "pulling my leg" in his descriptions of it. It was very steep, there was no footing in the slick clay, the path was a ditch; if you got caught in a rain it became the path of a torrent. We'd be lucky if no porter broke his leg, etc., etc.

Well—it is all of those things; also one may easily exaggerate them. We were two hours climbing twenty-two hundred feet from our camp on the spur up into a dark forest, where tree ferns spread their fronds, and then into the zone of mountain bamboo, such as I have seen in

Bwamba. A Gentleman in Search of a Wife.

the Patagonian Andes. The interlacing stems permit no passage except to the heavy shoulders of buffalo, a few of whom feed at these heights, or the slashing *panga*, the native's knife. Both forest and bamboo root in heavy yellow clay, holding back the water and making even the steepest parts of the track slippery. And much of it is as steep as a man can climb without touching his hands to the ground in front.

If this sounds difficult you must remember that the track is in constant use. Hundreds of feet have trodden out footholds, sometimes on roots, often just a step in the clay. Women carry heavy loads up and down. They think nothing of it and no one improves the path they tread.

We are at Kichwamba once more. The end of the safari is in sight. Only one more leg to go, past Lake Albert, and then we reach Entebbe and my friend Wayland.

XVII

The Last Lap of the Safari

We are once more on our way and are camped again at Wasa river in the Albert plain.

Fort Portal, the administrative center of western Uganda, is on the plateau about fifty-five hundred feet above sea. The site is relatively cool and healthful. The country is diversified by green hills and lakes. It is charming. And Ruwenzori raises its forest-clad peaks above the plain. The snowy heights or the clouds they weave about themselves are visible in the distance.

In this pleasant environment has long lived and still lives the King of Toro who, like the Maharajah of Udaipur, maintains the rule of his fathers under British direction. I was a little surprised, I confess, to hear that native kings still reign in Uganda; but there are four or five. Their ancient feuds are quieted, their boundaries allotted, and their sovereignty controlled for the good of their people. It is the wiser British way. But what patience the Lord Almighty need have as this poor humanity stumbles on the upward way!

I learn that espionage is not unknown to an African king; that his subjects, serving the British overlords,

hear and faithfully repeat; and that obstruction may sometimes develop even before a contemplated progressive step is ripe for action. Even so, British sense and British patience prevail.

That is not, however, my theme. We are once more on the march after spending four days at the pleasant rest-house, Kichwamba, and this morning we have come down two thousand feet to the foot of the escarpment that bounds the Albert rift valley on the east. The atmosphere is crystal clear after the downpour that nearly drowned us out yesterday afternoon. The views of Ruwenzori and of the Albert escarpment have been superb and my companion, enthusiastic photographer that he is, found it hard to pass by without photographing them. But we had already taken them when we came this way two weeks ago and we cannot afford to duplicate.

It is farewell to Ruwenzori. Though the heights may be visible as we march, they will be like a friend waving good-by. Long a name only or a phantom mountain of my dreams, it has become a reality and being very individual almost a personality.

It is one, not several. Certain highest pinnacles have distinctive names: Margherita, Alexandra, Stanley, Speke, etc.; but their last name is Ruwenzori. They are not separate as are the Mönch, Eiger, Wetterhorn, and Jungfrau. The gorge of the Mbuko, whose walls are four thousand feet high, may rival the Lauterbrünnen valley but, even as the Yosemite is a cleft in the Sierra Nevada,

so the Mbuko cleaves Ruwenzori's mass only superficially. That is a unit.

From the plain of Lake Edward to that of Lake Albert the uparched height is seventy-two miles long. Within this length are contained the dome, which is thirty to forty miles in diameter, and the Nose, which extends like a spur thirty miles toward the northeast. The dome carries the high pinnacles, exceeding sixteen thousand feet. The Nose declines from thirteen thousand feet, where it joins the dome, to two thousand feet, where it sinks beneath the Albert plain near Kibuku.

We first saw the long arc of the mountain profile when coming from Mbarara on the east, as we crossed the edge of the rift valley within which it stands. We watched the veiling clouds rise and linger, morning, noon, and evening. They never left the highest peaks, but we got glimpses of the snow, and the dome was clearly outlined from time to time.

We marched north fifty miles along the eastern base, looked into the Yosemite of the Mbuku, rounded the Nose, and went southwest thirty miles to the Bwamba country. Thence we crossed back. I will never climb the heights others have scaled, but I do not need to. I know Ruwenzori.

Ruwenzori is a mountain of many moods. She is like an Italian queen, whose bright smile allures, but whose quick, dark frown is to be feared. Nowhere else have I seen sunshine and storm pursue each other so swiftly.

On this hand is a brilliant landscape, all green, golden, and violet; on the other, in the shadow of a cloud, the tones are subdued and evened. The cloud advances. As it passes swiftly overhead its ragged front is seen torn by conflicting currents. The cold down draft struggles with the rising heated air. Now the light is shut out. The forested slopes of Ruwenzori turn a deep dark blue. They vanish in torrents of rain. Lightning flashes and thunder rolls. The storm is on.

With rare exceptions this play of the elements has been staged every day. It is not surprising that we have timed our movements to break and make camp while the sun shines, as we did today. Now Wasa Camp is once more deluged and I write to the tune of rain on the tent.

Ruwenzori has a secret no man has yet surely read. If you ask: "Why? Why mountain, stand you there? What are you as a feature of the earth?" Ruwenzori frowns and smiles. But I am not without hope of an answer.

Perhaps you may be interested to know how I got a hint. It was near the Hot Springs, before we went across the meadow to the boiling pool. The base of the mountain rose as a straight smooth cliff. Bwana Combe was sipping tea after lunch when I invited him to take a closer look at the cliff with me, but he would not leave the tea, though I urged haste as rain was coming. "Take what boys you want and go ahead." The forest belt along the base of the mountain was a fine place to look for an

elephant enjoying his siesta, so I took two boys with spears, one to cut trail, and Solomon to interpret. The elephant track we followed into the shadows did lead to My Lord's couch, but he had recently left for a stroll and we reached the cliff without difficulty. The natives watched me curiously as I examined the steep face of the rock. Why did Old Bwana look at the rock so closely? Why did he pass his fingers over its smooth surface? Why did he dig away the earth at the bottom and why the dickens did he, old as he is, climb up as high as he could, clinging to vines and sticking in his toes? Either one of them would have saved him the trouble if he had just said so.

But there was a reason. The cliff face was the surface on which the mountain block had moved past the block that lay under the valley. Had it moved up or sideways? Had it moved loosely or in spite of intense pressure and friction? The details of the surface might tell and they did. It was polished by intense pressure. It had moved straight up past the valley block. It had been pushed up. The rock face confirmed the testimony of the pinnacled heights and profound canyons of the mountain. Ruwenzori has been thrust directly upward above the surrounding valleys.

When we got back, Bwana Combe was ready to go to the hot spring, and we went.

The rain has ceased and I have been out for a walk through the camp. Our native porters, ninety in number,

have built a village of grass huts on both sides of the track, which has thus quickly become an African Main Street. Groups of four or five occupy a hut which is about six feet in diameter and five feet high inside. It looks like a beehive. They get inside, build a little fire in the doorway, cook their meal, and warm each other. They look comfortable. One of them is playing on a primitive stringed instrument, somewhere along the line. They show their strong teeth as they grin at Old Bwana. They were on the Bwamba trip and we are friends.

This is the second evening since I wrote at Wasa Camp and we have made two marches in the plain southwest of Lake Albert, the shore of which is only three or four miles away.

We have walked through a beautiful grassy park adorned with groves of trees and the tall shafts of the Borassus palm. Yesterday we followed a path to the water hole called Sindikwa, but today our guide has steered from landmark to landmark across the grassy level as a pilot steers from buoy to buoy in wide waters. For an hour this morning he laid his course by a distant but conspicuous palm until he came in sight of another that lay on our port bow. Steering for that, he came into a runway between groups of bushes where buffalo tracks are numerous and then into a vast meadow across which he led on to the trees that mark this spot. He is an interesting figure to follow, the guide. He is very tall and muscu-

lar, a native hunter, and he suggested bygone times as, spear in hand and head erect, he strode noiselessly over the plain.

He, of course, first saw the game, which abounds in this depopulated, unvisited area: the gray kongoni or hartebeest, who takes fright when one is still a quarter of a mile distant and lumbers away like a heavy cart horse; the wart hog, who sticks his tail straight up in the air instead of curling it like a proper pig; the water buck, a fine large animal; and the little dun-colored impala or "cob," as the English call him.

The cob is here in herds of hundreds. His curiosity and his fear contend within him to detain him and to make him fly. When he notices some one approaching he turns his head directly toward him, presenting his long narrow face, broadest at the top where the eyes are set, and surmounted by the bases of his black horns. They curve backward and upward and are foreshortened in the direct front view. His little tail twitches nervously. A herd standing thus have the appearance of being on parade. Attention, eyes front! One may approach within one hundred and fifty or even one hundred yards. Then the leader turns his head, gives it a toss, and from rigid stillness passes instantly into the long leap of flight. The others remain a second longer. All the dun-colored backs level out. The horns go back on the necks, they lean forward, they are off. The movement is a gallop in which the back and head remain almost at the same height

above the ground while the shoulders and flanks go up and down. The leaps are long and the hind feet overreach a foot or two beyond the front ones. Each take-off is thus farther forward than the last reach. It is a beautiful rhythm, shared by thirty or fifty or more. They do not go far, two or three hundred yards perhaps, and then they turn to look again, curiosity having overcome fear.

Elephants are quite numerous. Six were seen near the track and again a cow with two totos. But I was not there on either occasion. I have seen only one. As the afternoon was waning, he came sedately across the plain, slowly swinging his ponderous head. His very long tusks almost reached the ground. He had no idea of our presence as he came toward the water hole by which we were camped. When about three hundred yards away he went down into the channel, where he was lost among the trees. Whether he discovered us himself or was warned by the hyena who presently began to howl, we shall never know. That was at Sindikwa.

Here at Haibale we are even farther still from native villages and the abundance of game insures the presence of lions. About three months ago one was shot about fifty yards from where my tent is. Combe takes them seriously for he has ordered guard fires and does not go a hundred yards beyond them without his rifle. As it was growing dusk I went a little way on the plain to get the lion's view of the scene. The grass having been burned is short and there is nothing to obscure the figures

moving in the firelight. There are many fires, each group of our ninety porters having chosen a clump of bushes and built a separate one. They are scattered points of color in the gathering darkness. A group sits around a larger guard fire, talking and laughing. But for the fire they would be easy lion's meat. Just before sunset a herd of cob was near at hand and no doubt still is. Which would you prefer if you were a lion, man or antelope steak?

The risk is insignificant, but with a thought of home I will leave my lantern turned low. Good night.

It seems that I slept through the show last night. A lion purred his serenade, though distantly, and a hyena laughed at his own humor until he was booed from camp.

Here we are, practically at the end of the safari. It is the eighth of November and we are camped on Ntoroko Point at the southern corner of Lake Albert.

Yesterday's march had its unexpected features. We crossed the Wasa!

"How wide is the Wasa at the ford?" Combe asked the D.C. during a conversation at Kichwamba.

"Three or four yards and perhaps nearly waist-deep at this season."

But neither the D.C. nor any other of the few who come this way had ever seen the Wasa after such torrential rains as have poured down upon its upper watershed recently. We found it two miles wide and deep, very deep, in the channel.

Going Home from Market in Bundibugyo.

We began to have suspicion of trouble ahead as we waded knee-deep in a sheet of water that flowed swiftly through dense grass. It was no swampy meadow; it was a river and we were still a mile from where the Wasa should be. We continued to where the grass ended and the water flowed more swiftly. As the guide stopped I sounded eighteen inches—a foot beyond, eight feet and no bottom.

"No porter can carry a load through that," said Combe. But the channel was not wide. A little way upstream we found four palms conveniently placed for felling, and, after two hours' work with the knives and absurdly clumsy axes furnished by the British purchasing agent, a bridge was laid.

Do not imagine that we took any part in the work. "You don't keep dogs and bark yourself" is a saying Combe is fond of quoting.

No. Camp chairs were brought and placed on piles of grass where the water was not over a foot deep. Lounging comfortably in them we watched the work, which was directed by a native policeman and by Solomon, who came forward of his own accord. He is always a good waterman. He crossed on the first palm and, penetrating the thicket beyond, came back to report the way clear. After wading another mile we reached the higher ground, along which we came on to Ntoroko.

As our companion into this closed district we have the inspector of sleeping-sickness areas, Mr. Bell, a pleasant

young fellow who has not yet shot quite enough to satisfy an Englishman. He is an Oxford graduate with perhaps more preference for society than for academic learning. I was surprised to learn from him that Americans are on the whole rather an illiterate lot, as very few of them continue beyond the grammar school and not many go even so far as that.

I am reminded of a very British acquaintance en route in England to a meeting of the British Association to discourse on a literary topic. "I do not care to visit America," said he, "They are a people who do not read. I am told the houses are so small they have no room for books."

Our first day at this land's end had its characteristic interest. Combe and I are both delighted to see and eager to photograph the straight, steep heights that rise from Lake Albert. They more nearly correspond to the usual notion of a rift than anything I have seen during this long journey through the rift valleys. We set out accordingly, though the gray sky forbade photography, to explore the eastern shore of the point for good openings in the grass and thorn bush. Tracks of hippo, buffalo, and elephant being numerous, the big gun went along for protection, though we could shoot nothing in the game reserve unless first attacked. The twenty-foot bluff of the point soon dropped away to a long stretch of sandy shore backed by a meadow with trees—an ideal place for game.

Something snorted close by on our right and plunged into deeper grass. Opinions differed as to what it was and we did not follow. Crocodiles became numerous and sometimes disconcerting when they dashed out rattling their scaly armor almost under our feet. A little hippo took the water not a hundred yards away from us and swam out to join the family group of four others who were already taking their morning bath in the lake after spending the night browsing. They do not seem to fear indigestion. Yet what a huge indigestion a hippo might have! Their broad smooth backs occasionally rose out of the water like rubber balloons as they watched us, but for the most part only their funny little ears and their periscopes showed up. They deserved a leather medal for attention. Only once did I catch one of them looking away. He turned sidewise, raised his head, and yawned a mouthful.

Upon our return to the haunt of the crocodiles the inspector shot one, thirteen feet in length. With a bullet in its brain it went about its own length. Then it stopped and one would have supposed it must be dead, but it continued for half an hour to move its tail and hind feet as if knowingly resisting the natives who dragged it out of the water. They went about the task with evident reluctance and as far as possible avoided actually taking hold of it. Its conical teeth showed that it had not been familiar with pepsodent, or perhaps that it was old. In its stomach were the bones of a large fish that had been

swallowed whole and also numbers of pebbles up to an inch in diameter.

Waterfowl are numerous and the association resembles that which I have seen in Brazil on the upper Paraguay. A very large stork or heron dominates all the group. Here is one just lighting in front of my tent. He stands nearly or quite four feet high. His wings are blue-black to black as the light strikes them and when closed they cover his back completely, looking like a mussel shell or a cut-away coat. His breast and neck are white running into buff toward the head, and his great pointed bill is yellow. He is of a calm, deliberate temperament. He walks slowly; he shows no fear; he takes off majestically when he does not desire nearer acquaintance.

There are several other varieties of waders, among them the egret, the most beautiful and the most numerous. They frequent an ambatch tree near camp and cover it as with white blossoms. The timid creatures roost safely there, as the ambatch grows in the lake.

We came upon a flock of ducks, large plump ducks of a ruddy, almost pheasant-like plumage. "Oh, my God!" exclaimed Combe "Isn't that dreadful! Look at all that lovely food! I know a dozen ways to cook ducks." But he respected the game preserve.

Two more of the big storks have just lit near by. I got the field glasses and now see that they have a tuft of red feathers where the plumage ends between the shoulders, and the neck is naked. The top of the head is dull red

and black and the hinge of the bill is just under the beady black eye. They have walked about over the inspector's deserted camp (he left this morning) and have decided there is nothing worth picking up. One of them looks at the other, half opens his beak in a grin that splits his head almost to the very back, and says, "Come, the fishing's better in the lagoon," and away they sail. One had already breakfasted. A full pouch of the skin of the throat hung down a foot on his breast. The other showed no pouch at all.

We are now camped at Kibero halfway along the southern shore of Lake Albert, where the *Samuel Baker* landed us and where I have had a chance to study the escarpment closely.

Various experiences have occurred since I last wrote at Ntoroko Point. We photographed, Combe shot three or more crocodiles, we heard hyenas laugh and lions grunt their deep, full-chested "ough, ough." And we waited for the steamer. If she failed us, as Combe seemed to think quite likely, we should have to make a push to get back to Fort Portal while the food lasted, for there was none to be had in the depopulated area. She had last touched at Ntoroko to land the Prince of Wales, and prior to his coming five years had elapsed since any but native fishermen had been there. They are forbidden to enter the sleeping-sickness area, but their huts and the remains of fish showed that they come often. Why not?

The bwana says they shall not, but he stays far away. It is easy to land from a canoe and easy to slip away. The fishing is good. Their fathers and their fathers' fathers fished there.

"No doubt they reason in some such way," agreed the inspector, "but they are poachers. They come over from the Congo side. They pay us no head tax or fishing license. They sell their fish beyond our territory. They must be discouraged." He burned the grass huts, even while he admitted that nothing but a police boat would keep them away. The real point, of course, is that one native carrying germs of sleeping sickness can infect the tsetse flies and undo the results of years of quarantine.

Saturday evening, November ninth, our camp was struck long before dark. We had supper early. Then we watched for the steamer's lights, our own beacon fire blazing high to guide her. She was due at eight o'clock and when at that time her lights had not yet shown up, I made up my mind we would wait some hours. So I made myself a bed in the grass, of a folded camp stool and a raincoat, and arranged myself to sleep. Combe wandered restlessly about, chaffing his boys and disturbing my peaceful slumbers.

"Crocodiles," said one of his boys, "lay eggs of lizards, scorpions, and poisonous snakes."

"Yes," replied Combe, "and you will lay the egg of a donkey," whereat the company roared with laughter.

It was after eleven when a light appeared and an hour later that the steamer whistled. Then it seemed time to leave my nest and presently Combe and I were put aboard in a cockleshell of a rowboat. Being a passenger, I went to bed, but Combe remained up three hours longer till the last load was brought on board through a rising sea.

It seemed quite reasonable that he should be weary on the following day and I let him sleep, much as I wanted to discuss the beauties of Lake Albert. He was still tired when we landed at Kibero and on the following morning said I should have to go out alone. He had fever. After staying in bed yesterday, he climbed this morning fourteen hundred feet from the lake to the plateau but then gave out and was carried into this camp whence we will go on by motor.

Combe's illness illustrates a condition that seems to be not uncommon among officials here. In the course of years of service, they become permanently infected with fever, but acquire sufficient resistance to keep it down until they are subjected to strain. Then the germ asserts itself. The hours of wading in crossing the Wasa told on him. He was not himself at Ntoroko, and the fatigue of the night in leaving there knocked him out. We are very fortunate in having reached assistance.

I am deeply indebted to him. Without his intimate knowledge of native tribes, languages, and living conditions in this region this safari could not have been

organized successfully. He not only knows the headmen by name, but is known to them as a friend, and his word, though imperiously asserted, goes with them as that of a strong man of good faith. He tells me he has never before been so long associated on safari with a white colleague.

That massive head of his contains a driving intellect and a great memory. His own purpose turned him from life in the bush to studies in Sydney University. When, at the age of eighteen, he went into the mines, where living conditions and associations as he describes them were of the lowest, he persevered in mineralogy and even in microscopic petrography. He is very widely read in geology and he remembers not only what he has read but what he has observed in the field. I count him one of the ablest field geologists I have met in Africa.

My day on the shore of Lake Albert, walking beneath the escarpment that walls it, is a day to remember for the deep impressions of beauty and interest it has given me. Alone with Solomon and three other silent followers, I was free to relish my enjoyment. On the one hand lay the waters of the lake stretching away to the half-veiled mountains of the Congo shore. On the other rose the steep slope, generally green with the light green grasses or the darker green of acacia-like thorn bush, but occasionally precipitous and of rich brown or red color. The zone between the shore and the steep is like a park in grass and shade trees. The whole was beautifully sunlit, except where purple cloud shadows chased each other.

Two beautiful water bucks waited in the shade of a tree till I was within five hundred feet of them. Perhaps my kodak caught them as they sprang away. Hippos groaned and I thought of fat prima donnas. It takes bulk to produce such notes. Large crocodiles eyed us hungrily as we sat on the shore, lunching ourselves but not lunching them.

The great show, however, was at the Babcons' Roost. It is a cliff that stands on one side of a deep ravine, a ragged cliff next to the ravine, but a very smooth face toward the lake. Its overhanging ledges, corners, crannies, and pointed rocks were alive with baboons. They began to bark a sharp single bark as we approached the base of the talus slope and they went frantic as we climbed to the cliff. While I examined the rocks, the older ones came leaping down within forty or fifty feet of us, while the youngsters raced to and fro on the higher ledges. The old fellows scolded us, threw stones at us, and showed their contempt by a most improper gesture which differed from that of street gamins only in that they could not slap their behinds since they stood on their hands while they kicked up their heels. Their erected tails, however, supplied any needed emphasis of suggestion. My two companions, Solomon and Tomas, were hugely amused, barked back, also threw stones, and comported themselves somewhat like larger baboons. When we retreated, the baboon tribe celebrated its victory by wildly chasing each other over the rocks and barking joyously.

I fancy one might meet with serious resistance if one climbed into their private residence. They are powerful beasts, somewhat like a large dog but with four hands to hold what they bite. I have heard of an English geologist whom they followed. He ran at them. They stopped but came on as soon as he turned away. As they grew bolder, he fired his shotgun and wounded several. Enraged, they then charged in earnest and he ran for his life.

The escarpment engaged my attention in other ways also. It is the most characteristic rift scarp possible, a straight face which cuts off the valleys and spurs of the high plateau as by a knife and might serve as a textbook illustration of a real "fault scarp," that is, the actual plane of fracture itself. As it rises from eight hundred to a thousand feet above the lake, it is a very striking feature of the landscape. The waters, however, do not reach the cliff. A wide slope of talus intervenes.

Where did the talus come from? Off the scarp, of course, and by that much the face must have been worn back behind the real fracture plane. On close examination one finds that the scarp varies in steepness according to the inclination or dip of partings in the rock, being steeper where they are more nearly vertical, as is the case at Baboons' Roost.

This condition robs the escarpment of the significance that has been attached to it. It is simply a superficial result of the difference of elevation between the plateau and the lake basin. It gives no clue to the origin of that

difference. One is free to agree with those who attribute the rifting to a tension that pulled the crust of the earth apart, or with Wayland who holds that it is a result of pushing the masses up and together.

Realizing that this classic example offered no definite proof by which to settle the question, I was returning to camp after an eight-mile walk and scramble. It was about two p. m. and the vertical sun was hot, real hot. The back of the negro in front of me was marked with fine dark lines that ran straight down, where drops had run or were running. It takes some heat to make a negro perspire when he is just walking, I thought. I looked up at Baboons' Roost, just a little way ahead, and at the cliff beyond it on the farther side of the ravine. Then I stopped and looked again. Crossing the face of rock and curving back under the plateau was a distinct line that divided the masses of rock above and below it.

If I saw aright, the line represented a curved surface on which the upper mass had been pushed up over the lower, the surface of an upthrust fault. There was the evidence of compression, perhaps. But I was almost dizzy with the heat as I have been only once before on this safari, and I might not be seeing straight. I sat down in the shade of the tree where the water bucks had stood, and cooled off. Then we climbed once more to Baboons' Roost, and while the tribe exerted itself to the utmost, I studied and photographed the thrust, for such it is.

The thrust is strong proof of Wayland's contention. He has repeatedly visited Kibero, since there is an oil seep in the neighborhood, but he may not have been south of the village or he may not have looked up at the right moment. I am glad I did, and so closed my work on Lake Albert with a definite observation.

When I got back to camp, Combe's condition gave me something else to think about. It would be best to move on and his two hundred and twenty pounds would have to be carried. My gold-medal cot was available to make a stretcher, but it would do only if strengthened by tent poles. I woke up in the night tying dream knots around dream cots, but it worked out all right in the morning and the surprising strength he showed in climbing the scarp made the porter's task comparatively easy. Four stout short men were selected. Eight men lifted him on the cot to their heads and they walked away with him at a trot.

Soon after our arrival here a car appeared with a friend of Combe's and another official, and they will return for him tomorrow.

We are pausing in the resthouse at Hoima one hundred and fifty miles northeast of Entebbe, a day ahead of schedule, thanks to Mr. Gower, A.D.C., and his motor car which brought us two days' march early this morning. The porters will also make the two short marches in one day and will get two days' pay for it. If they are tired tonight, they will be pleased tomorrow.

Combe, a Visiting Chief, and Escort.

Hoima is a beautiful illustration of the landscape gardening with which the English surround their official centers. The residence is a low roomy house with a veranda and is overgrown with a vine whose scarlet flowers remind me of the trumpet creeper at Idlewild. In front is a close-cut lawn and there are flower borders with nasturtiums, gladioli, peonies, pink amaryllis, and cosmos of various bright hues. A mass of bougainvilleas covers an arbor. At one side of the house is a rose garden. The whole crowns a broad hilltop, commanding a fine view of the valleys and hills about and reached by avenues of eucalyptus.

The well-kept grassy spaces and the ornamental planting of trees extend for a quarter of a mile around, including the grounds about the *boma*, the official buildings. They are kept up at official expense, but the garden around the residence depends on private initiative; and a bachelor D.C. who takes over after the flower-loving wife of his predecessor does not always bless her.

XVIII

Uganda to Kenya

HERE we are at Entebbe. It is November eighteenth. We are one day ahead of schedule, thanks to the friends who picked us up the other side of Hoima and cut out a day of walking. Otherwise we should have arrived precisely to the day as planned by Combe.

In my experience it has not been usual to arrive exactly on schedule when traveling in supposedly wild countries. It strikes me there must be an excellent understanding between the native chiefs and the British authorities where the former cooperate so effectively with the latter as they have in carrying out the orders for this safari. It is about four months since Combe laid the plan of marches before the Governor of Uganda. From him it was transmitted to the several district commissioners. Up to that point one would expect British efficiency to operate. But from there on the details were intrusted to native chiefs, passed on to village headmen, and by them conveyed to villagers whom they selected to serve as porters, to the number of forty, seventy, or in some districts even ninety. We changed porters probably twenty times and must have employed nearly a thousand during the sixty days the safari

continued. During that time the natives met punctually the requirements of our need according to orders, on the date, at the place, in the numbers stated.

It is quite likely that many of them did not want to serve. Portering is a form of forced labor, in the sense that it is done because it is required and not voluntarily. It should not be required simply to enable a millionaire to shoot an elephant, but where, in the judgment of the authorities, the service is a proper one the requirement is consistent with native practice under the chiefs, just as it is with more civilized peoples, when a farmer works the roads or pays a substitute. The manner in which this service was rendered, punctually and cheerfully, promises well for the future citizenship of the blacks of Uganda.

Entebbe and bougainvillea are synonymous in my thought of this place. It is an extensive park. Its green lawns and beautiful trees are touched here and there by notes of mingled cobalt and carmine, the brilliant masses of bougainvillea that hide the cottages. The fairways of the golf links contour the slope that descends from the main driveway along the edge of the terrace from which the dwellings overlook Lake Victoria. The governor's residence stands on a higher hill. The first secretary's is on a point of the terrace, a hundred feet above the lake—an enchanting situation—and the office of the Geological Survey is on the fifty-foot terrace immediately over the water. It is claimed that it is the only geological

office in the world from which crocodiles may be fed, and a certain professional pride in this antediluvial association is expressed by the corps.

There is nothing antediluvial in the organization, however, nor in its work. Young in years and in spirit it carries on very actively under the able directorship of my kind friend, E. J. Wayland, from whom came the initial invitation to study the rift valleys. His own intimate studies of the Albert rift have resulted not only in an original explanation of the mechanics of the structure, but also in an interpretation of the effects upon the history of rivers and of prehistoric man in this region. He first detected the fact, which Combe has since abundantly demonstrated, that the streams now tributary to Lake Victoria were confluents of the Congo before the rift valleys began to develop; and he has been most assiduous in correlating the stone implements found upon the river terraces with successive stages of culture, and these with the changes of level that have produced the actual geography. Under him the Uganda Survey has risen above that low plane of strictly economic investigation to which unintelligent legislation would limit it and is working toward the acquirement of that scientific understanding which is essential to sound economic development. He tells with a smile of the search for the source of pebbles of tin ore found in the Kafu river. Any old prospector would reason that they had been carried downstream, but it took more than a prospector's

understanding to recognize that the river had formerly flowed toward its present head and that the source of the pebbles was in the opposite direction.

The views over Lake Victoria and its environment contrast sharply with those around Lake Albert. Here is a wide, inviting land, there a narrow shore under steep escarpments. Here the outline of promontories and bays is sinuous, there the lines are straight. One can better understand Wayland's description of the "long, continuous rifts" of the Albert trough. I did not find them so continuously long as I expected, but was impressed rather with the manner in which they die out and are continued in an offset position. But they are comparatively long and straight when viewed against the mental background of the Victorian landscape of Africa or of England.

A week has passed since I last wrote—a week of pleasant leisure and companionship with Wayland in his delightful home. We have motored over the rolling country (that is a most unscientific description, but I like it better than "a country of low relief in an advanced stage of mature dissection"), have been to the hilltops whence we could survey the swampy embayments in the drowned valleys, and have noted the terraces that mark higher levels at which the lake formerly stood. From the changes of level one might reason that the waters had withdrawn into a deepening basin, as to a slight extent they probably have; but lakes other than Victoria show

similar shrinking within their former shore lines and the cause is a general one. There were no doubt variations of rainfall in Africa as there were variations of snowfall in Europe during the glacial period, and it is to climate rather than to warping of the earth's surface that the changes of water level are to be attributed.

Tomorrow we shall motor to Kampala, the near-by commercial center of Uganda, and thence to Ripon Falls or Jinja, at the point where the Nile flows out from Lake Victoria. Wayland and Dr. John Evans, the senior among English geologists, will be my companions to that point but will then leave me to take the train to Nairobi while they will go to visit Mt. Elgon, one of the very large volcanoes of East Africa and one of the oldest.

Alone in Africa! This is my sad situation for almost the first time since I landed six months ago. Also I am alone at the Place of Killing, Jinja. These were my thoughts as I sat waiting for dinner in the Ibis Hotel at Ripon Falls after Wayland had driven on. But if alone I was not unknown. Presently a round, rosy-faced, perspiring gentleman rose from a distant lounging chair and came across the room to me.

"You're American, ain't you?"

I assented.

"Thought so. Your name's Willis. Heard of you from friends up at Hoima. They say you walk twenty miles a day! I'm American too, Kaintucky, tobacco . . . Not

walking any twenty miles a day though. Glad to know you."

To which I responded by inquiring as to the success of the British-American Tobacco Company in persuading the natives to grow and cure desirable grades of tobacco at a much more moderate price than that demanded by white planters in the Salisbury district. My new friend had been five years in Africa developing the supply and, being in a genial mood, as his approach to me indicated, he gave me an insight into the working of his methods. His presentation of the case of the white farmer against the native competitor would not encourage me to invest in an African farm.

The gist of his argument runs thus: The white farmer carries an interest charge on his investment and a cost charge for his family which are out of all proportion to the charges borne by the black. The black is ignorant, unorganized, and slow. But the handicaps that the white must meet are inexorably fixed. He never can escape them and remain white. The ignorant black can be trained to raise crops satisfactorily, he can be organized under the chiefs, and his self-interest can be stimulated to speed up production. Big business can attend to these details, and it not only can but will when there is profit in so doing. My friend spoke with conviction born of experience and success.

There in a nutshell is the future of the white farmer in tropical Africa.

As the train bore me from Jinja eastward I realized with satisfaction that only the Eastern rift valley, the Great Rift valley of Gregory's description, remains to be examined. And now I have crossed it for the first time and have reached Nairobi, the starting place for all big game hunters, whether they are looking for elephants or for giant kobolds of the subterranean world, as I am.

From Jinja we ran for hours through the low hill country and across the swampy river channels, characteristic of all the region north of Lake Victoria, until we began to climb toward Mt. Elgon whose misty mass arched broadly against the northern sky, a purple silhouette in the early evening light. Deep canyons and high lava-topped promontories bear evidence to the antiquity of the volcano, which long ago ceased building up its dome.

During the night we crossed the equator, my third crossing in six months. At Equator Station, I am told, a Canadian grows wheat and has appropriately named his holding Canada Farm. He has exchanged fifty degrees of latitude for nine thousand feet of elevation and finds himself in a climate on the line similar to that which he enjoyed in Canada, except that he can never hope for a bracing winter day.

Canada Farm is on the lava plateau that forms the eastern rim of the saucer in which the waters of Lake Victoria gather, and we ran on toward the edge, the margin of the Great Rift valley. My first glimpse of

the valley was at Nakuru, an ambitious little town on the slope of the still steaming crater of Menengai. In traversing fifteen hundred miles of rift valleys I have become accustomed to the almost complete absence of the precipices that are supposed to wall them in like Norwegian fiords; but I had hoped to see high cliffs along this, the typical rift valley of rift valleys. I even wondered by what ingenious plan of twisting turns the railroad would descend the steep. But by comparison with my expectations it was a tame landscape that met my eye. The railroad runs nearly straight down the long slope, through Nakuru and out on to the valley floor. Lakes Nakuru and Elmenteita are gathered in shallow basins under low cliffs of lava, such as one may find in almost any volcanic field. I wonder what Gregory saw. Did he think the escarpment was buried under the flows from Menengai?

The absence of precipices where, if anywhere, precipices ought to tower majestically to the sky and stretch away to the horizon still bothers me, although the eastern escarpment that we climbed in leaving the rift valley is a striking feature. From Nakuru we ran down to the basin of Lake Naivasha and past the volcano Lonongot that stands in the middle of the valley. Then we climbed eleven hundred and fifty feet to the plateau and from its edge glided down a gentle grade to Nairobi. The views from the train as we ascended the escarpment were very fine. Had I not expected more spectacular cliffs they might have

appeared impressive. I shall have to adjust my scale to these comparatively Liliputian dimensions.

I have now been two days in Nairobi and have seen something of its activities. The administration of Kenya colony centers here and is carried on by a group of officials of the Colonial Office, gentlemen who serve the Crown. There are representatives of the English shopkeeper, striving after a fashion to compete with Indian traders; and there is an active element of ex-army officers seeking to establish themselves on the land or taking part in the business of hunting.

Hunting is the conspicuous activity. Many are the establishments that undertake to fit out safaris, and very busy are the parties who almost daily arrive at or depart from the hotel with guns, cameras, and camp equipment of bewildering variety. Among the hunters there is occasionally a seasoned, silent veteran; but the majority are loquacious tenderfeet with more money than experience, of a type at one time commonly met in our Far West.

These are apt to make their first acquaintance with big game by driving out to the game reserve by night to watch with eager delight and a shiver for the glowing eyes of lion or leopard, who backs away from the auto's headlights. Later on they will roll out from a luxurious camp at some chosen spot in "wildest Africa" and, having strolled a short distance from the motor car, will be posted where they can shoot at a lion. He, poor beast,

has learned to look upon the hunter as a friend, since for several weeks past zebra or hartebeest have been shot for his breakfast. He has no idea he is going to be shot himself. He may even get angry if hit in the rump instead of the head. But he has no chance, for beside the "sportsman" stands a hunter who is employed not to miss.

Solomon has become reconciled to city life after a fashion, but he will be as glad as I to strike the trail once more. Poor Solomon! Nowhere in his young life has he previously met the attitude of contemptuous tolerance that is apparent here, nor perhaps seen the type of "nigger" it breeds. Myself quite unconscious of it, I tipped the head porter of the Avenue Hotel, as usual on arriving, and asked him to direct Solomon to a decent and comfortable lodging. Two hours later I found Solomon still waiting, sitting on the sidewalk, hungry and dejected. His worn shirt and shorts, though clean, were not in it with the swagger uniforms of the hotel boys. He was homeless, friendless, waiting for his bwana to appear. On inquiry I find that there is no place for blacks in town overnight. They must go to the native compound some four miles away, and there is no conveyance except shank's mare. Thither Solomon perforce conveyed himself and his belongings after I had seen him well fed.

"Many motor cars," said Solomon, perhaps fifty being in sight on the three or four blocks of the main street. I laughed, but I have to remember that this busy little

mart is the biggest town he has ever seen and there are many novelties. He carries himself with a certain dignity in public, nevertheless. In my room, however, when I snapped on the different electric lights, he gave way to his delighted surprise in chuckles of glee.

Fortunately for Solomon and for my temper also he will be taken care of during my future sojourn in Nairobi by Gethin, Captain P. Gethin, an Englishman with whom I have made arrangements for motor cars and outfit for the coming excursions. It was six months ago that I first heard of Captain Gethin when inquiring of fellow passengers for the most reliable man in Nairobi. They were British officials of long service in the country, and my experience fully confirms their recommendation.

Gethin having made all things possible, we are off tomorrow on the first trip. The objective is the southern section of the rift valley, where Lakes Magad and Natron spread their bitter waters in long narrow troughs. The map looks like rift country.

In contrast to the well-planned safari conducted by Combe this is a dash into the indefinite. The track, to be sure, is known, to Lake Natron at least; but there it ends, and what a geologist may want to do when he gets there and how he is going to do it the wit of Nairobi sufficeth not to tell. If only I wanted to kill something, the something could easily be found; that is what Nairobi is organized to do. But when a man merely wishes to see he-doesn't-know-exactly-what and he-doesn't-know-

exactly where, Nairobi anticipates trouble for him and backs its anticipations by statements of fact.

Lake Natron is not a pleasure resort. The plains about it are glaring white and the tropic sun is hot. The escarpment beyond it cannot be climbed, and if one did find a way up one would be on a waterless plateau. Beyond the end of the track it is possible to proceed only by foot safari. Porters could not be persuaded to go and none might be coerced. Rhinos are numerous. It would be folly to go without a gun. If I would go I should certainly engage an experienced "white hunter" as life insurance.

Since Gethin, who otherwise does not paint so dark a picture, agreed with others on this last point, I have thought it best to accede, but right here I struck the trail of the American millionaire, who pays from five hundred to a thousand dollars a month for that kind of service. In one sense I feel worth as much as any millionaire, but my dollars are worth more to me than his to him. Whom could I get?

Having discussed Jones, Brown, and Robinson as possibilities, Mr. Whitman, president of Safari Limited, recommended J. B. Lucy. "He is one of the very best," said he. "He knows the country thoroughly. He may not want to go, however. He was mauled by a lion a year ago and he has not been out since."

Gethin and I found Lucy at his shack on a coffee plantation he had recently bought, working in his garden.

With the first greeting I knew that I wanted him. Frank, hearty, and cheery, he is evidently a good camp companion. Tall and soldierly, he carries himself like a gentleman. As a veteran of four wars, in which he fought always in the line of shock troops, and as an experienced hunter he is a man of tested courage, and as it proved he is modest.

When we had sat down to tea and he had learned what I proposed to do he said, "I'll be honest with you. If we should get into a tight corner—with a jolly rhino, say—your life might depend on my nerve. They say a man who has once been mauled by a lion never gets back to where he was. I advise you to get some one else." I did not take his advice, however, and he is going along as life insurance, just to test his nerve. I hope we will see a "jolly rhino," though not necessarily for that purpose.

There is one place I particularly want to visit and have been told I cannot. It is the giant crater of Ngoro Ngoro. It lies about eighty miles southwest of the north end of Lake Natron, where the track ends, and there's the rub. All the giants of difficulty, despair, and possible death await him who shall venture into the inhospitable beyond.

"Impossible," said Mr. Whitman. "We used to do it with ox wagons and porters from the other side, from Arusha. Took two weeks each way. No road, no water for seventy-five miles. Ngoro Ngoro is one of the most inaccessible places in Africa."

Now a giant crater twelve miles across is unique. Twelve times the diameter of Nyamlagira, four times that of Kilauea, the great caldera of Hawaii! Think of it! a molten sea, the huge throat of Hell's biggest furnace, more scientifically described, perhaps, as an outlet of a magma basin or a gas furnace of unusual size located over a system of rifts and fissures.

Fritz Jaeger first explored it in 1910. Barns visited it in 1923. There ought to be some way to get there now. If there is, Captain H. L. Sikes, director of Public Works for Kenya, will have made it possible. A companion of Gregory in some of his excursions and himself an author of a very accurate description of a section of the rift valley, he has courteously taken an active interest in my studies and has demonstrated it by telegraphing to the director of the Soda Works at Magadi that I should like to secure porters for a foot safari beyond Lake Natron. This opens up all sorts of possibilities.

GREAT RIFT VALLEY

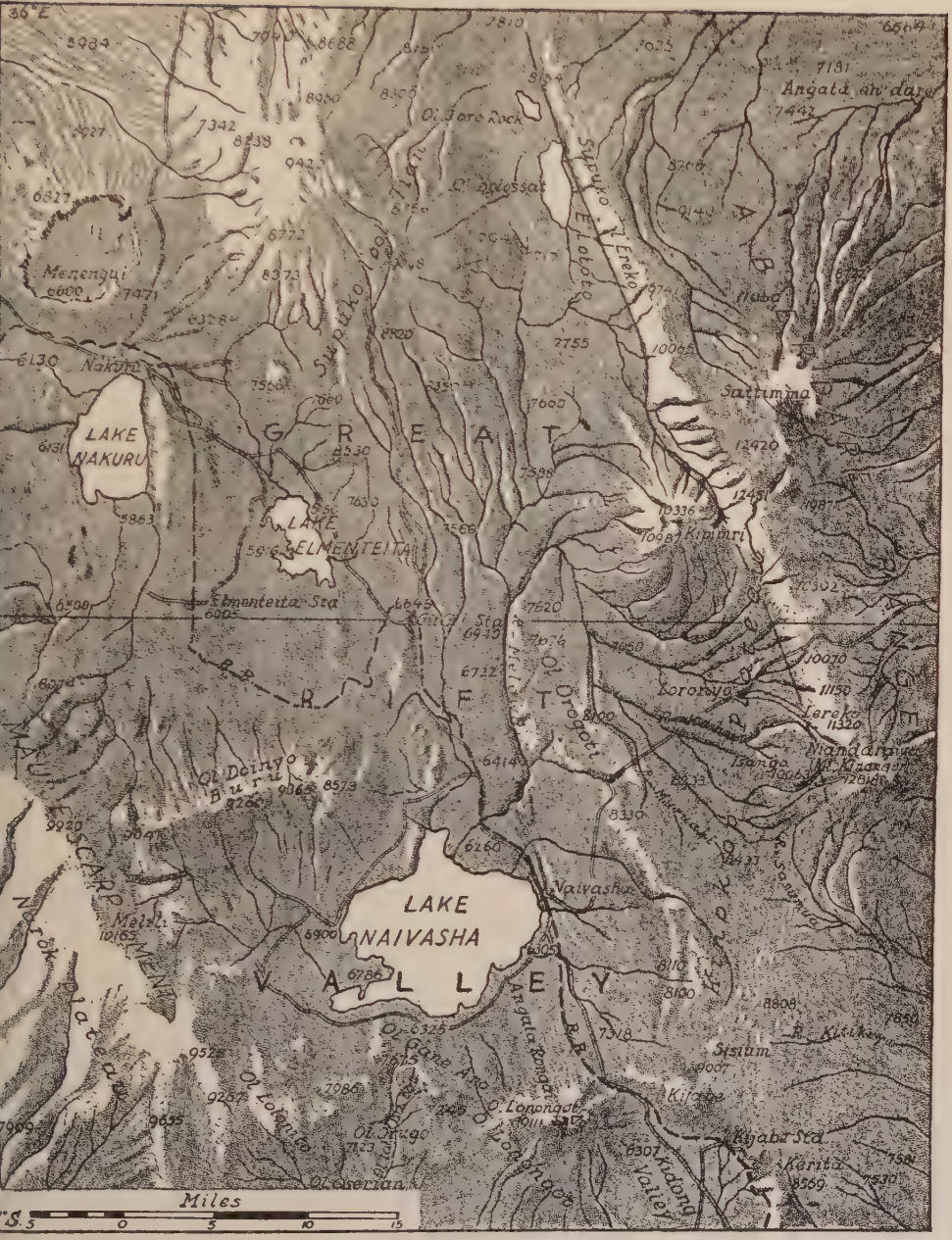
THE *map represents the central section of the Great Rift Valley in Kenya colony, between the Aberdare range and the Mau escarpment. The greatest difference of elevations is about 6,000 feet. A pronounced rift or fault defines the western escarpment of the Aberdares and shows a vertical displacement which varies from about 300 to possibly 4,000 feet. The major elevations are volcanic piles. The fault cannot be traced south of Mt. Kinangore. From the base of the Aberdares the surface steps down to Lake Naivasha by several minor faults not shown on the map but suggested by the course of the Melawa river.*

It has been assumed that the Mau escarpment represents a fault, the opposite of that which defines the Aberdares, but none can be seen in the long slope which probably corresponds with an unbroken flexure.

Lonongot, Doinyo, and Menengai are relatively young volcanoes that have erupted through the valley floor and are still steaming.

Evidences of occupation of the valley by men of the Stone Age are found near Lake Elmenteita and elsewhere throughout this section. They comprise stone implements, human skeletons, and the bones of recently extinct animals.

Sketch map drawn from the Nakuru-Nyeri sheet of the 1:250,000 *map of the East African Protectorate.*


36° E
Angata ah'daya
Ol Doreo Rock
Ol Doinyo Eibor
Menengai
Nakuru
LAKE NAKURU
GREAT
LAKE ELMENTEITA
Elmenteita Sta
RIFT
Ol Doinyo Burru
Ol Orogati
Lorotuya
Kiptimri
Sattimma
Ol Doinyo Eburru
Naivasha
LAKE NAIVASHA
VALLEY
Meiz.
Ol Lonongot
Kijabe
Kijabe Sta
Karita
Miles

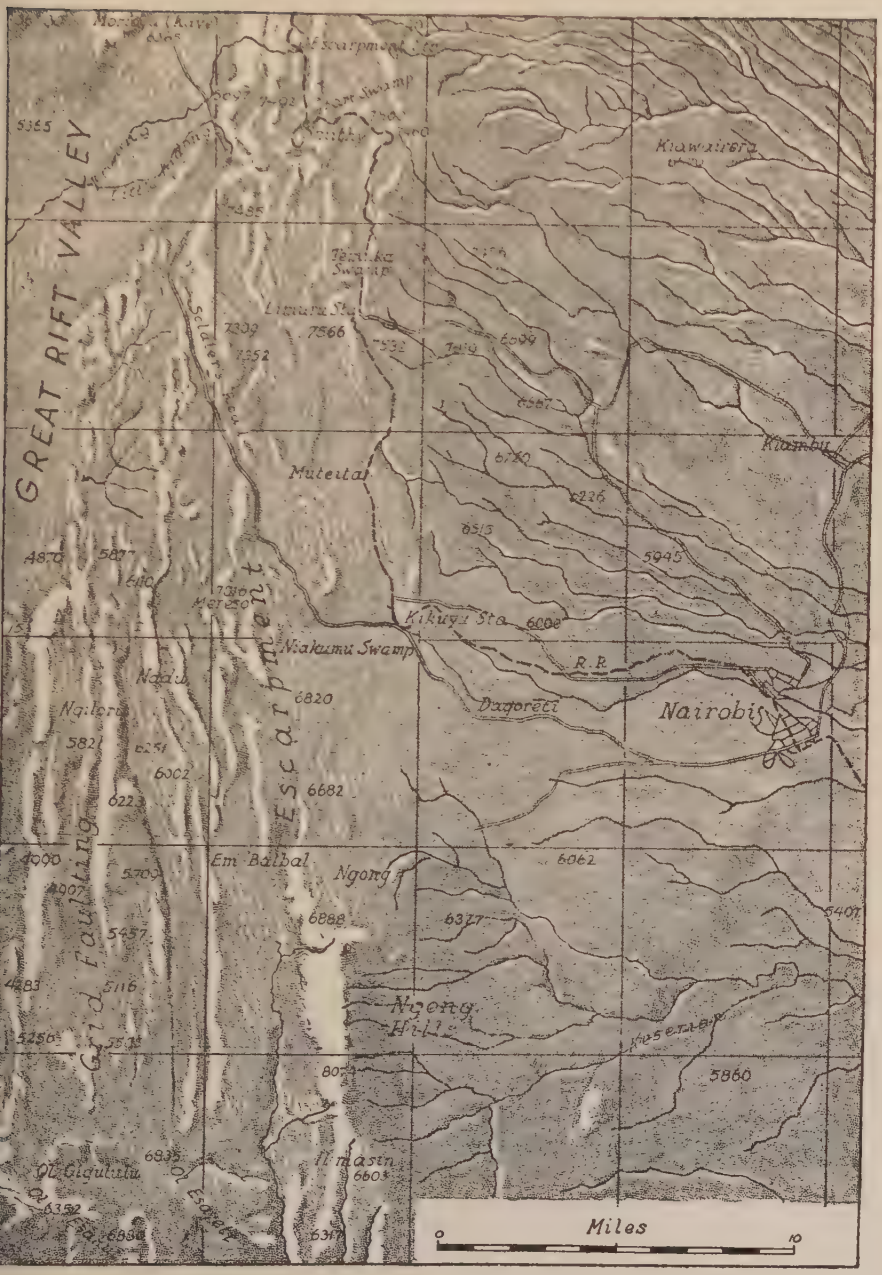
NAIROBI—ESCARPMENT

West of Nairobi the escarpment of the Great Rift Valley is formed by a succession of faults that descend like steps from the plateau to the valley floor. The steps are short and offset one from another. Any individual one is at most a few hundred feet high. The total vertical displacement varies between two and three thousand feet, as may be seen by the elevations given on the map. It is greatest at the Ngong hills, which owe more than a thousand feet of their own height to the piling up of ancient lavas on the plain.

The long slope eastward consists of sheets of lava which, in decomposing, have formed the rich soil upon which coffee is grown. Rainfall is heavy on the plateau but light in the rift valley, diminishing rapidly west of the escarpment. It is noticeable that there are no deep gaps or passes in the rim of the escarpment such as would represent ancient canyons if a high mountain had ever stood over the site of the rift valley and the latter had been formed by its collapse. The author infers that the region was formerly a plain of lava at or below the level of the rift valley floor and that it was gently arched up, leaving sections behind as it stretched in arching.

A typical "grid" of faults is shown in the southwest corner of the area. It consists of strips that stand higher or lower in alternation.

Sketch map from the Nairobi sheet of the 1:125,000 *map of the East Africa Protectorate.*


GREAT RIFT VALLEY
Escarpment
Mutetai
Kiambu
Kikuyu Sta.
Nairobi
R. P.
Dagoretti
Ngong Hill
Em Balbal
Ol Giqulitia
Miles
0
10

XIX

Rhino Country

MAGAD, bitter! The native word that appears as the name of several lakes in the rift valley accurately describes them. Bitter is the water, bitter the salt-encrusted soil, bitter the thirst of the region.

Our little two-some left Nairobi early, the seven-passenger Buick leading, the Chevrolet truck following. Lethbridge, expert mechanic, drives the Buick, with Lucy, Solomon, and me as passengers. An Arab driver and three boys come in the Chev. We are provisioned for two weeks, there is a large water tank in the truck and we carry all the gas (petrol) we can. A coil of two hundred feet of wire cable is available if only one car is stuck or to rope in an elephant if they both should be.

It looks like an experienced, efficient outfit. I know I can count on Solomon; I have every confidence in Lucy; and Gethin vouches for the rest. We have left care behind and are free in the open.

From Nairobi we drove through the beautifully cultivated suburbs, in which charming villas and gardens are set in coffee plantations, crossed the rolling upland of the plateau toward Ngong hills, and descended the escarpment to a terrace in the rift valley. There we

turned southward and have dropped from level to level, descending altogether about four thousand feet, from over six thousand to two thousand above sea.

A parallel and a contrast have been in my mind as we drove along a stony track. In California, east of the Sierra Nevada, Owens valley descends similarly from a region of lava plateaus to a closed basin, Searles lake, in which chemical deposits have accumulated. The valley is depressed between great heights, much greater heights, indeed than any here—the face of the Sierra Nevada being many times higher than any difference of altitudes along the rift valley. Owens valley is bounded by geologic faults on both sides and may properly be described as a rift valley. The faults are what geologists call "normal," which implies that the section of the crust in which they occur has been elongated; and in the case of the Sierra the elongation was caused by the vertical, upward movement of the mountain blocks as they were raised. The effect is that which Gregory recognized in this region, but the cause is a stretching over a rising mass rather than a horizontal pulling apart by some general tension. I wonder if Gregory saw things as they are, but went too far afield for an explanation.

The chemical deposits would naturally result from evaporation in any closed basin, but that does not seem to be the only condition of their concentration in the Magad lakes. There is an unusually large supply here from hot springs. Soda is the principal ingredient and it,

along with silica, seems to be derived from the soda-bearing volcanic rocks in consequence of their decomposition by heated waters at some moderate depth. This implies a source of heat that must have been such as to have maintained a high temperature for an indefinite period, and, while heat is assumed in volcanic regions, its long continuance means a continued supply of energy. One possible, though superficial, source of energy, suggested by investigations of the Geophysical Laboratory, is to be recognized in the combustion of gases escaping from within the earth, along fissures of notable depth. The vulcanism, the rifting, and the hot springs that bring the soda from the zone of decomposition, all seem to be related. It looks like a promising clue, connecting the rift valley with heat and volcanic activity, but it does not point to any close relation with the Albert rift or with others that I have seen.

Ngoro Ngoro, Ngoro Ngoro. The name ran in my mind.

"Have you ever been to Ngoro Ngoro, Lucy?"

"Yes, two years ago. Took a motor car on a bet across the Zerengetti plains and down into the crater. Seventy-five thousand head of game there. I realized what murder that meant when others followed me, and I had the game warden make it a game reserve."

"Could you do it again?"

"What? Take a car in? Why certainly."

"We won't want those porters," said I, after a bit.

As it happened we could have gotten them, thanks to Captain Sikes and the good will of Mr. Gill, the manager of the Soda Works, who, however, was plainly relieved that I had changed my mind. Having lived thirteen years at Magadi, he could better appreciate what they were likely to suffer on a march down the desert valley or over the plateau.

Thirteen years in that torrid desert! Yet Mr. Gill looks young and smiling, and I met little Master Gill, aged a few months, out taking his airing about sun up, that being the only time of day when one of his years could venture from under a roof.

We have been most hospitably entertained and well advised by our kind hosts at Magadi. Lucy had thought we could find a track leading northwest up the river called the Guasu Nyeri, which flows into Lake Natron, and that we might thus reach the Zerengetti plains, across which he would take us to Ngoro Ngoro, allowing five days from Lake Natron to the crater. But the northwest track was pronounced impassible unless we were prepared to build a road up the escarpment and it is evidently better to go back to Nairobi, whence we shall take the road usually followed by hunters going to the Zerengetti plains.

We have come on to the Fig Tree camp, beyond the Guasu Nyeri, where General Buick got stuck in the river and Chev had to pull him out. Our outfit is pitched beside a bright running stream that comes out of a ravine

in the escarpment, and we have as temporary companions three Canadians who are here to shoot rhino—"poor, jolly old rhino."

The run from Magadi to this camp occupied only part of the morning. We had plenty of time to pitch the tents, eat lunch, and get restless. Strolling out beyond the shade of the large trees beside the brook, I could see the escarpment on the western side of the rift valley and it tempted me. It ranges from two to four thousand feet in height. Parts of it are quite precipitous, and it cuts through older mountains, some of them ancient volcanoes and others residual island mounts, left by erosion. If I could reach it I might, perhaps, start back with a clear conscience for Nairobi and Ngoro Ngoro in the morning.

Leaving Solomon to cook the dinner, Lucy and I took two other boys to carry gun and camera and set out for an afternoon walk. We held westward, ascending to a broad bench land in which streams have cut shallow canyons, where basalt cliffs and shady retreats looked inviting for leopards or possibly a lion, though the scarcity of game made the latter improbable. Studying the landscape I shaped our course. Lucy following occasionally took the rifle from the boy, where he thought quick action might be needed. We started a few wart hogs and antelope. There were many fresh spoors of rhino and Lucy would say, "If I were hunting I would follow that." I think he regrets my complete indifference. The

old hunting instinct is strong in him and he was moved to tell me stories:

"Poor old rhino," said he, as we paused in the thin shade of a thorn bush to look at a fresh spoor that wandered aimlessly around, "he's so near-sighted he is nearly blind. He goes blundering along not knowing where he is going. Poor old rhino."

"How does he get you then?" I asked.

"Once he gets your scent it is all up with you or him. He never lets you go until you kill him. There was Mrs. Green, a great traveler and writer, they say. She was staying at a farm when a native came in to say there was a rhino in the maize. The farmer had only a small gun and said the rhino could jolly well stay there. Mrs. Green claimed she could get him. She put five shots into him and he got thoroughly annoyed, so much so that he chased her and ripped her limb from limb. Then he went down the road and meeting a Ford with a man in it he killed them both. But then somebody shot him. Poor, jolly old rhino." Lucy's tone was sorrowful. His sympathy with the blundering beasts is delicious.

We had gone on past mid-afternoon but were still a mile or two from the escarpment. One of the boys said it was two hours farther. His feet were burning with the heat of the white baked ground. Whenever we paused he would pick out a relatively cool spot of shadow and standing in it on one foot would rest the other on his knee. It was plain that we would not have time before

dark to climb to the cliffs and get back to camp, but the light on the mountain was beautiful and tempted me to photograph. I was pushing on to an outlook when a huge red cloud rose behind us. It was the desert that had risen up on the wings of the wind. The center was dark orange and toward the margins the half tones changed to ruddy yellow against a vanishing blue sky.

I snapped my kodak ten seconds before the view was swallowed up. Then we lay behind a thorn and waited. There was no great wind, such as I have experienced in dust storms elsewhere. The whirl no doubt passed us by, though the day was blotted out. "Look at the moon," I called. But it was no moon. It was the ghost of the sun peering through the dust.

Evening was on when I approached the brook and entered the belt of tall trees somewhere in which camp was pitched. Lucy and the boys had fallen behind. They did not answer to my shout. My life insurance had temporarily lapsed. When they came up to where I waited Lucy remarked, "Just the place to bump into a jolly old rhino." I doubt if I would have run far if one had appeared. I was more tired than I wanted to admit, and Lucy's new found strength had reached its limit. Yet we had walked scarcely twelve miles. The heat gets you if the rhino doesn't.

It is late. The boys are snoring. A stentorian rhythm comes from a high platform where some from the other camp have climbed to security from predatory body

snatchers. Lucy is still over there with the Canadians and their white hunter, an old companion of his, who told a rhino story on Lucy himself earlier in the evening.

It appears that a rhino caught Lucy without a gun and most unsportingly pursued him. As the rhino was gaining, Lucy, in running past a small tree and to the left of it, grabbed the tree with his right hand and swung around it. But the rhino came up on the right of the tree. The laughter that greeted this climax prevented our learning whether Lucy jumped the rhino or embraced him.

We back-track tomorrow to strike out for Ngoro Ngoro, "the most inaccessible place in Africa."

XX

Big Game and Giant Craters

THREE days have passed. We have camped near Nairobi and are now far away on the other side of the rift valley en route to the Zerengetti plains.

Going to Lake Natron and back I saw on either hand slopes, escarpments, or volcanoes bounding the view from the track that runs longitudinally along the rift valley. Again, from the eastern plateau to the western, the traverse of the valley shows only escarpments, plains, or slopes of volcanic nature. But where I approached the cliffs west of Lake Natron I recognized the old foundation rocks, gneiss and quartzite, and now that we have come far south on the western plateau we have again left the volcanics. We are camped among hills of the ancient rocks that underlie the broad plateaus of Tanganyika and Rhodesia. We have left behind the special problem of the rift valley and are facing once more the general question of the African highlands. The latter involves the uplift of the continent. Why should the zone of the rift valley be a local exception, the reverse of uplift? I have an idea it is not an exception, but just a difference in degree and mechanism.

The hills among which we are camped are of the type and date of those I first saw in approaching the Fufu scarp south of Dodoma and whose contemporaries have been seen widely distributed on the plateau—residual hills standing like islands in the vast smooth surface. They have a German name, *inselberge* or island mounts. This group is peculiarly interesting since it seems to have constituted a central height, a summit of the continent before the rift valleys began to develop. During ages that I hesitate to estimate, though in geologic terms I should say since the late Mesozoic at least, the rains falling upon these little mountains have gathered in rivulets to feed great rivers that flowed west to the Atlantic or east to the Indian ocean. Now they flow to neither. If they choose the old westward course that led to the Congo, the waters gather in Lake Victoria, whence they turn to the Nile. If they run eastward, they evaporate in the bitter lakes. Rivers always have interesting, sometimes almost tragic, stories to tell.

This is the country of the big game hunters when they are after antelope or lion. All varieties of swift, horned creatures abound in the wide, grassy valleys, in the open growth of thorn bush; and the shallow, shady ravines afford excellent cover for crouching, gliding beasts of prey.

We came upon a characteristic elemental act in this drama of life as we started out this morning. Hard beside the road lay a zebra. Two lionesses and four well-grown

cubs slipped noiselessly into the grass and shrubs with which their coloring blended perfectly. I saw a lioness move and saw her no longer; she had stopped and become part of the undergrowth. We left the car and gathered around the zebra, which was still warm. Lucy pointed out the few marks of claws that showed how it had been killed, and described the expert manner in which the big cats habitually get their prey.

"The lion runs up beside the zebra (always on the left, for he is right-handed), throws his right paw over the withers, and grips with his claws in the zebra's right shoulder. Here are the marks."

"And there they were, deeply sunk into the flesh, but not torn.

"Then he puts his left paw over the zebra's eyes and pulls his head around. Blinded and frightened the zebra stumbles, falls and breaks his neck."

There on the zebra's nose were slight scratches, confirming exactly the action of the killer. There were no other marks, except that the soft skin of the belly had been ripped in a first bite of breakfast.

"That's the work of the lioness," said Lucy. "She always goes for the soft parts."

Too much interested to look around, we had not for a time noticed his Majesty, the Lion, who stood about fifty yards away, waving his tail in grave annoyance at the interruption of his breakfast. He was beautiful and most interesting to watch. Standing in the shadow of a

tree he would not have been easily recognized but for the slowly waving tail. Trying to trace his outline from the fine head to heel, I lost it here and there against the background, yet I sensed power. We would have been defenseless had he charged, for the guns were in the Buick, but Lucy knows his lions. In fact, he is quite intimate with them.

It is little more than a year ago that he was driving lions, as a good white hunter drives for his patron, who on that occasion was posted beside a donga into which five had been chased. One might think the odds a bit heavy, five to one, but Lucy had often driven lions. He didn't even pay attention to what was in front of him as he ran, and rudely kicked one of the inoffensive cats in the stomach. It was quite inadvertent on Lucy's part, and he thought the lion would recognize the fact though the latter gave an involuntary grunt, as one might expect, being hit below the belt. The lion rose to his feet and moved off, whereat Lucy thought the incident closed and started to go.

"The next thing I saw," says he, telling the story of his mauling, "was that huge red mouth and those big paws about seven feet in the air. I had just time to think: 'Give him both barrels and turn the left shoulder' and to do it, when he struck me. We went down together. He clawed my head and chewed my arm and shoulder. Then he lay still, dead or waiting for me to move, like

a cat. I didn't know which and I didn't dare move. It was a long time."

Well, one must admit that no self-respecting lion could have done less.

Spring is coming over Zerengetti. The rains are due and countless herds are moving up toward the plains. The does are heavy with young and soon will be accompanied by their long-legged, queer-looking fawns. We came upon one, a hartebeest, standing in the shade of a large tree where we passed within six feet. "See her dodge behind the tree," said Lucy as she stepped aside and stopped. But she was not dodging, she was preparing to fight. There stood her little one, not an hour old, trying to hold itself up on the weak props of its straddling, trembling legs. We did not disturb the mother and baby.

We are passing among thousands that are moving up in anticipation of the green grass that will soon clothe the brown plains. Zebra are here in herds of ten to fifty, and one is seldom long out of sight of them. Without exception they look too fat to run, nor are they swift. Their rotund bellies and round sleek haunches, beautifully striped, move with the gait of a fat pony, the children's pet. "They are darlings."

Tommies (Thompson's gazelle) are here by thousands, hundreds in a herd and hundreds of herds. They are the most charming little creatures imaginable. When the Creator designed them he drew a broad black stripe from shoulder to haunch with a single upstroke of the

brush and smiling saw that it was good. He had modeled the figure with exquisite delicacy. He mounted the pretty head on a slender neck and endowed this gazelle with the spirit of a playful, happy urchin. They never fail to race the car and, outrunning it, they invariably dash across in front. No matter how close the race for the last one of a hundred or more he never turns back. They pass within fifty feet of the car, and with such action! You cannot see their legs. Then safely across, they change the long leaps to a staccato jumping, up and down in one place with all four legs stiff, and, cocking their heads first on one side, then on the other, while they switch their tails energetically, remark with intense satisfaction, "Motor cars are not in our class!"

The big hartebeest and his purplish twin, the topi, are ungainly, awkward creatures, who evoke a smile as they too cross the track, but lumberingly. Quite as often, however, they run away, having none of the dash of the tommies.

Of all misshapen quadrupeds the gnu or wildebeest is the most so. His antelopean hindquarters are altogether too slight for his shaggy, bull-like shoulders and head. His antics suggest those of a hunchback. I tried to approach on foot a herd of some two hundred, in order to snap them. They quickly became interested in me, ran to hide one behind another and, peeking out, snorted, threatened, and finally galloped away like heavy steers on the range.

The wart hog is a scream. Excuse me, but he is, you know. And when he is little he is a perfect darling of a scream. We chased several families just to laugh at the absurd figure they cut, their inquisitive noses trying to outrun their periscope tails. One plucky old lady turned to face the car while her piggies ran away. Every wart on her ugly head bristled, but she bolted from the horn when it tooted within thirty feet of her.

The variety of animals is astonishing. In one day we have seen nineteen different kinds, most of which I would not recognize with any certainty, but regarding which Lucy has many intimate observations to relate. Among them are the tiny steinbok, only fourteen inches at the shoulder, the familiar cob whom we saw in such numbers on the Albert plains, the beautiful, staglike waterbuck, the eland, and the Grant's gazelle, all of them presenting different types of build, color, and horns. The hyena and the jackal, wretched offspring of Nature in some hopeless hour, slink away. Wild dogs, not often met, leaped from our approach and dashed into the bush, but we had a good look at them. They are of powerful wolfish build, smooth-haired and whitish with black blotches and big, upstanding ears. Lucy showed more interest in them than in most of the animals, because they are rarely seen.

Nothing to my thinking is more beautiful, though extraordinary, than the giraffe, whose height and motion bring to mind the tall sailing yacht, bending and swaying

to the breeze. And nothing contrasts with his grace more strikingly than the baboons and long-tailed river apes as they hustle, creep, scramble, and run somehow, anyhow, to satisfy their curiosity.

These snapshots of the wild life about us may give some idea of the migrating herds and their followers; but to see it, live with it—that is the real joy of it. What would not a John Burroughs, a John Muir observe? What delight did not Akeley find in it?

We are near the end of the hunter's track. Although one can drive a motor car almost anywhere, or perhaps because one can, there are no permanent wheel ruts in the expanse of the Zerengetti plains. Tomorrow we shall strike out across them on our own.

We are in for it now, whatever is ahead. Ngoro Ngoro is but a few miles farther and we are bound to get there, even though it prove that what has been overcome was only "Troublesome" and that "Devil's Creek" and "Hell-for-Certain" lie before us, as Daniel Boone and his companions discovered in crossing the Cumberland mountains to Kentucky.

This morning, when we had left the last belt of trees and ascended the first long swell of the trackless plains, I sighted a compass course, as one might at sea, and we held it—south twenty-five degrees east—for fifty-odd miles. The plains are not featureless nor are they flat. Kopjes of granite boulders fifty to a hundred feet high form landmarks by which to steer, even when a higher roll of

the ground shuts out from one in the trough the view of distant volcanoes. We kept the blue dome of Ololmoti on our port bow, knowing that Ngoro Ngoro lies somewhat to the right of it as we were going. We made good progress, something like fifteen miles an hour, and could have done better much of the way had it been possible to see the wart hog holes in the grass. But they can swallow a wheel and to drop into one, as we repeatedly did, jars things up a bit.

Lucy was on the lookout for landmarks among the distant mountains on our left; Lethbridge was on the alert to keep General Buick out of trouble, and I constantly compared the changing outlines on the horizon with the features of the map. In strong contrast to real exploration, we know where we are going and we are going with the most modern means of transportation. We ride in comfort, almost without fatigue. There is no weariness of mind or muscle, no uncertainty of food or drink, no hard test of endurance. Our only risk is that the tireless power we command may fail us through the breaking of a spring or the stoppage of an oil pipe, and that we may be thrown back upon our own puny strength. Then indeed we should be pushed to it to cover these miles we so easily put behind us.

It was noon when we left the high plain and ran down toward the first of the ravines cut by the streams that run from Ololmoti. They had for some time been objects of our anxious scrutiny, for any one of them might block

our way to the slopes we must traverse to reach our objective. This one was fringed by trees and large bushes, but the thickets did not worry us since elephants had made wide pathways to the stream. It was in the ravine itself that our difficulties would begin. And so it proved. Walls of rock three to ten feet high are not to be negotiated by motor cars, not even by Buicks or Chevs. Rather forgetful of life insurance, I ran eagerly up the dry watercourse till I came to a group of water holes where the stirred-up mud and wet rocks warned me that some largish beast had recently been there. I glanced into the thickets and somewhat quickly climbed over the dry site of a little waterfall above which the banks looked more open. It was as if I had come out upon a road. There was a smooth pass across the channel and but scanty bush on either low bank. Lucy and Lethbridge were already examining the stumps of larger trees that had been cut off with an ax or some tool heavier than the knives carried by the Masai of the country. We were at a loss to imagine who had been there, but the stumps were old and we could only guess that it was some earlier visitor like ourselves. At any rate we seemed to be on the right track.

Proceeding toward a long spur that looked very promising, we crossed two more ravines, though they were more difficult than the first. General Buick and Chev behaved nobly, reminding me of a little boy's description of a horse that "stood first on his front legs an' then on

his hind legs, but I held on by the hair on his neck." Lethbridge handled the car very skillfully and the Arab showed himself fully competent to follow with the Chev. Eventually ascending the spur we were surprised to come upon wheel tracks. Though overgrown they were plainly marked, crossing and recrossing one another, the tracks of heavy wagons that had been mired down to the hubs. Then Lucy guessed the truth. We had struck the military track used by the Germans in 1917, when they occupied the district and subsisted on the abundant game in Ngoro Ngoro. These were the marks of their ox wagons. I could just hear the *Donner Wetters* and *Ach Himmels* with which they had struggled through the deep mire, driven on by the urgency of war.

They had been there during the rains. A growl of thunder came from Ololmoti's turbanned summit. I glanced with anxious thought at the blue-black soil, which was like rubber under our tires but which could so quickly be turned into grease, and I hoped that neither Lethbridge nor Lucy was thinking of the possibilities.

Water was our next need and we hoped that the old wagon tracks would lead us to it. As the afternoon drew on we came upon two Masai boys herding cattle, which they were driving across our track. With a little difficulty, for they were shy, we persuaded them to enjoy the entirely new experience of a ride in the Chev and to direct us to a spring. The discipline that governs these warlike natives was not lacking, however. Presently the

younger boy, perhaps thirteen, asked to get down and ran to gather up the scattering herd, which he drove off to the *manyatta* in a hollow of the hills. The older, carrying a beautiful spear of Masai make, went on with us and is staying where we have pitched camp by a spring that runs from beneath a lava flow.

I want that spear!

And now I have it, safely hidden for the present at least, under my blankets. Not that I have robbed the boy, but I think I might be robbed of it. The Masai rightly value their spears very highly, much as a hunter values a rifle he could not replace.

I let the boy look through my view finder and took his photograph. He seemed to understand that I wanted to be friendly and (to Solomon's great indignation) put his hand to stroke my gray whiskers, saying in a surprisingly soft voice, "*Mzee, Mzee*" (Grandfather).

I took the coveted spear in my left hand and, holding in my right a big clasp knife, I touched a spring in it. Out jumped the long blade. He wanted to do it and quickly learned, but he handed it back and, drawing his own eighteen-inch blade from his belt, laid it beside my toy. You could split the skull of a man or a leopard with that heavy, double-edged knife of his. Taking it up I felt the edge. It was dull. Having a carborundum whetstone handy I quickly sharpened the soft iron while he watched. Then I offered the clasp knife and the whetstone. He shook his head.

Presently he began to finger my bush shirt of solaris cloth, tan outside and red underneath. "He wants Mzee to give him a shirt," interpreted one of the boys. So I got out my only other one and he put it on, patting himself delightedly. A mirror was brought and his vanity was more than pleased. He made no objection when I put the spear in my tent. And yet I do not feel quite satisfied. The spear is a family possession, possibly handed down from father to son. A perishable shirt is a poor exchange for a warrior's weapon.

The Masai are a nomadic fighting tribe, among whom a youth must blood his spear or, in our phrase, kill his man before he can hope to marry. No doubt this spear has been blooded, probably by the boy's father, and would be blooded again if the boy kept it. A Kikuyu or Kavirondo working in his field would furnish the blood, or possibly an Englishman or woman, for the feeling on the part of the Masai toward the whites is none too friendly. It never has been, and just now the young men of the tribe are ready to go on the warpath. In consequence of a prolonged dry season their cattle are starving on the steppe, and recently when they drove them down into the Lumbwa country, invading their more peaceful neighbors as is Masai custom or Masai right, they were turned back by black British police. A Masai was shot—without provocation, say the Masai; "because he threatened me," swore the policeman. Who shall say? But white settlers armed their wives and

MASAI.

The Father: "I Have Not Seen the Boy."

The Boy Who Got My Shirt.

daughters in Kenya. The talk I heard in Nairobi recalled stories of trouble and massacre on the Indian border of our American colonies two centuries ago.

The young Masai I have seen in Nairobi and here on the plains are slender, but athletic fellows of bold bearing, reminding me of the Sioux Indians I used to know on our western plains fifty years past. They walk the streets of Nairobi with the air of free savages, not deigning to gaze into shop windows or manifest an interest in the white man's wonders. They ask no favors except to be let alone, to live on ox blood and goat's milk, fit food for men, and to fight as brave men should.

Their respect for courage is shown by the monument they have piled up for Andrew Dick by the rock where they speared him sixty-odd years ago. Dick, a stubborn Scot, started out one morning single-handed on a punitive raid against the whole Masai tribe in the rift valley below Nairobi. During the day he shot more than forty, but toward sunset, as he retreated, his gun jammed or he ran out of ammunition, and his clubbed gun proved no match in fencing with a Masai spear. Following an ancient custom of natives in Asia as well as in Africa, the Masai have each tossed a stone upon Dick's rock as they passed, in token of their respect for a brave man.

The spear is gone and I am not likely to see it again. The boy did not go back to his manyatta last night. Darkness having closed in, he could not go safely for fear

of leopards and lions, so he slept with the boys in the lorry, where they all barricaded themselves since we were camped by a resort of lions. He slept warm in his shirt. Morning came and we broke camp. Still he lingered.

"He wants his spear. He says it is his father's spear and he dare not go back without it."

"Give me the shirt then," said I. Very reluctantly he began to pull it off. I weakened. "Keep the shirt. The spear is mine, but I will lend it to you till I come back and claim it at your manyatta." But as he walked off I said to Solomon, "That's good-by spear."

Solomon laughed. "Yes, sir. He get your shirt. He keep his spear."

We have come on seven miles nearer to Ngoro Ngoro and are camped about six miles from the rim at the end of possibilities for General Buick and Chev. I have had my first glimpse of the vast hollow from an outer cliff of volcanic rocks, but that lava flow came from Ololmoti, not from the giant crater.

The boys have done well to get this far. Lethbridge in particular has carried on well, though sorely against his judgment. He knows his cars from A to Z and loves them. When they suffer he suffers too. He suffered some this morning. The feats those cars performed, twisting in and out of deep ravines, were marvelous. There was one bank, of about two cars' length from creek to top, that stalled us for an hour, the wet tires slipping in the blue-black soil in spite of brush and chains. I was about to

cry "enough" when Lethbridge rushed it with General Buick, all hands pushing.

Lethbridge does not mind demanding the utmost power the cars can give, but he is deadly afraid of hidden stones in the grass. Late this morning the front axle hit a rock. The poor fellow's nerves were already on edge. All the blood in his body went to his head and yet, though his voice shook, he still kept the deference English training had taught him. Where some men I have known would have exclaimed, "I'll be damned if I will go a foot farther!" he said, "I'm sorry, sir, but we can't go on." He fears to lose the cars, not because of the fix we would be in but from a sense of responsibility to Gethin.

Having ascended from that slippery ravine to a high, smooth ridge, we stopped to get our bearings. Ololmoti's great mass rose on our left, filling the eastern quadrant of the view. It is a very old volcano, cut almost in two by a canyon several thousand feet deep. Lucy and I shared an eager longing to explore the depths of that dark gulf. But old though Ololmoti is, it is younger than the giant crater, for the lava from the one flowed into the other. The long, smooth surfaces, now deeply soil-covered and grass-grown, constitute the slope on which Lucy descended with his car into Ngoro Ngoro two years ago. He wanted to guide us in that direction and once more to visit that game paradise, but I felt it would be foolhardy to dare the ascent of the two or three thousand

feet we would have to attempt on the return. Ololmot was warning us.

We therefore turned southwest, directly toward the nearest part of the northern escarpment of Ngoro Ngoro. I must be content to look into it from some point on the rim and return before the rain breaks upon us. As we approached the brook on which we are camped, Lucy and I walked ahead to prospect for a way through the thorn thickets, and he saw what I am sorry to have missed—a lioness leaping away some twenty paces from me. He mentioned her afterwards, just to warn us not to stray far from camp after dark. Pussy may be watching me as I sit here under my tent fly, writing by lantern light. She probably is divided in her mind between fear of this strange light in the dark night (it is heavily overcast) and desire to taste this queer animal—me.

A water buck got the surprise of his life this afternoon and so did Solomon. For an instant both were in the middle of camp, then the buck was gone and Solomon was recovering his poise in my tent, where he had entered with less ceremony than usual. The buck, probably pursued by a leopard, leaped the brook, landed shoulder to shoulder with Solomon, and left. His jump across the brook was twenty-four feet.

We had scarcely pitched our camp when two Masai walked in and sat down. They were the father and perhaps the grandfather of our boy guide. The father asked where the boy was; he had been out hunting for

him all night, he was very tired and hungry. We fed them, sitting under my tent fly.

What did he know of the shirt and my spear? Nothing. He had not seen the boy.

Presently his eye wandered to the Chev and he said to the older man, "That is where the boy slept last night." He spoke Masai, of course, but one of our boys translated.

"He knows the boy slept in the lorry, but he has not seen him. He has been out hunting for him all night. The Masai lies as usual." Lucy's tone was that with which Leatherstocking was wont to speak of the Hurons.

As they sat there their eyes roamed everywhere about the camp, not only over the cars but also into the near-by bushes. Presently they got up and walked about. Then they drew our boy aside and questioned him. What were we doing, hunting? Where were the hides and horns? We are in a game reserve. The Masai informer gets one half of the fine imposed for illegal shooting. It would be a clever hunter who could escape their ten thousand pairs of eyes.

They left after telling us what we already knew, that the cars could go no further, and also what I do not believe, that one cannot get down into the crater from this side. But there is little chance that I shall have an opportunity. Ololmoti is growling. This afternoon Lucy and I walked to the first commanding cliff, beyond which there is a long flat and a rise to the rim itself. A big

baobab tree stands conspicuously on the highest part about six miles from here. We shall make a dash for it in the morning, even though we should have to hurry back.

I am leaving this lantern burning for pussy's sake.

Last night I slept fitfully. In a half-conscious nightmare I saw General Buick and Chev sunk deep in black mire and abandoned to the Masai, struggled on foot hopelessly mile after mile across desert plains, staggered thirsting to a pool that vanished with a loud noise, and woke to peals of thunder and rain on the tent.

Dreams sometimes come true; sometimes they do not.

The morning broke clear and we were up to greet it. Having given Lethbridge his instructions, I started with Lucy and two boys for the twelve-mile dash to Ngoro Ngoro and back. There was no path—only game trails to guide us in the general direction—but they would naturally lead toward and perhaps into the crater. We moved swiftly and directly.

Arrived at the baobab tree on the commanding ridge, I was disappointed at first sight to see another, lower terrace edge between us and the crater and then astonished to note that the rocks where we stood were not volcanic. Blocks of white quartzite, mica in the soil, and great boulders of granite, all indicated unequivocally that we had come upon the foundation rocks through which the lavas must have been erupted.

We descended into a ravine and crossed as quickly as possible to the front of the lower terrace, half a mile away. We walked all the way on the old rocks and saw capping them a thin sheet of lava, the far end of a flow from Ololmoti. No lava had risen from the supposed crater in front of us. The mass of old foundation rocks was much too large to have been floated by any volcanic activity, however enormous. On the farther rim we stood on the edge of a section of the rift valley, not on that of a giant crater.

In vain I ran my field glass along the escarpment as far as I could see it, searching for the characteristic columnar forms or bedded layers of lava flows from a crater, such as are built up around Nyamlagira and Kilauea. The northern side, on which I stood, exhibits only the forms peculiar to the ancient crystalline rocks, such as were under my feet.

In vain I surveyed the floor of the wide amphitheater, looking for sporadic cones or minor craters such as one would expect from having seen Crater Lake in Oregon and similar large calderas. The floor appears smooth. Whatever unevenness it may have originally presented is hidden under deposits of volcanic ash and of salt from the waters that evaporate in the flat.

On our left, toward the northeast, the salt pan merged gradually into slopes covered with bush and grass that rose in long, sweeping curves to the rugged heights of the dissected volcano, Ololmoti. The smooth curve is that of the base of the volcanic cone built up of lava flows, ash

eruptions, and wash. It is not broken by any cliffs that could be distinguished at a distance of ten or fifteen miles, and Lucy, having driven a car down it to the floor of the depression, bore witness to the complete absence of any cliff whatever.

Toward the southeast the distant view beyond the floor is of low hills and wide valleys, which might have any possible origin so far as the forms indicate, but which are probably cinder cones or other minor volcanic vents standing in plains of volcanic wash. The southern side of the great hollow shows similar topographic features, but toward the southwest one sees faintly in the far distance the forms of large mountains, no doubt the volcanic peers of Ololmoti.

After examining the view from every direction accessible from my outlook on the northern rim, I was forced to conclude that the walls of a great caldera were lacking and that the more probable explanation of the so-called "giant crater" is that it is a section of the rift valley, locally overwhelmed by lava flows from the copious eruptions in and around it.

Having taken the necessary pnotographs I heeded Ololmoti's warning and, casting a final look into the valley two thousand feet below me, where elephants or rhinos stood in the shade of large trees, I led back to camp at double quick.

As we snatched a quick lunch we learned that pussy was still on the watch. Lethbridge, hoping to get a guinea

fowl for supper, had gone out fifty yards with the shotgun. A movement in the grass led him on, gun ready for a bird on the wing. But he knew better than to shoot when pussy jumped out, and he did not stop to pet her.

We did not linger over our bite of lunch. The cars were ready and we knew just where to drive. Backtracking was much easier than pathfinding had been; the soil had not yet softened below the grip of chains, and the steeper grades were in our favor. As we rolled down the old German track and crossed the northern, outermost ravine, Lethbridge stopped General Buick and looked back. We realized that we had barely escaped Ololmoti's grasp. Rain blotted out the foothills we had crossed.

"We got out just in time," said Lethbridge.

GIANT CRATERS

The district of the Giant Craters lies in northern Tanganyika territory, where the Eastern rift valley branches and forms the Eyasi rift valley and the Manyara rift valley. Both of these are bounded on at least one side by very definite cliffs due to faulting. The great volcanoes, Lemagrut, Ololmoti, Elanairobi, Loolmalassin, and Oldeani are ranged along the fractures.

There is a broad depression known as Ngoro Ngoro, which lies among the volcanoes and has been described as an enormous crater. But, as the rocks of the northern rim are not volcanic, it is probably a section of the Eyasi rift valley blocked off by the great volcanoes.

In 1917, during part of the operations in East Africa, the German force lived in Ngoro Ngoro and subsisted on the herds of wildebeeste. The area is a game paradise and is now a game reserve.

Sketch map after the one by Dr. Fritz Jaeger, in Das Hochland der Riesenkrater, one of the series of publications relating to German explorations entitled Mitteilungen aus den deutschen Schutzgebieten.

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XXI

The Great Rift Valley

All this time I have been neglecting the classic regions of the Great Rift valley, described by Gregory and Sikes and now made doubly interesting through discoveries by L. S. Leaky, the archeologist, and J. D. Solomon, the geologist, who have been unearthing bones and artifacts in the vicinity of Lake Elmenteita. To the geologic problem they have added the fascinating question of the antiquity of man in this region, and they have gathered evidence to suggest that he may be a very ancient inhabitant indeed. They even think he may have witnessed the later developments of the rifting to which the valley owes its character. If so we shall have to change the time scale, either by hurrying geologic processes or by greatly prolonging the stone age of man's evolution.

We returned from Ngoro Ngoro to Nairobi without incident, except that in crossing the Zerengetti plains we wandered like the wildebeests, of whom there were many, and involved General Buick and Chev in almost impossible gymnastics. And then, when within forty miles of Nairobi, we encountered several cars stuck in the mud on the highway leading to that metropolis and

should have been stuck ourselves had not Lethbridge been an exceptional driver.

Baringo, Naivasha, Kapiri—I have read of them all, but they remained mere names until I visited them during the excursions of the last few days—Lake Baringo, the northernmost feature of the rift valley reached by Gregory in his daring exploration of 1893; Lake Naivasha, the central basin from which the waters once escaped by a deep canyon across the lava flows from Lonongot; Kapiri, the typical district of rift faults described by Sikes.

According to all that we could learn at Nairobi, Baringo was almost as inaccessible at this season as Ngoro Ngoro. The road up the valley is a track in black cotton soil and is impassable because of the rains. Farmers have not been coming in from the outlying farms for some days past. It would be a waste of time and money to attempt the trip. All of which proved quite true except the conclusion, there being a rough but thoroughly serviceable road of which Nairobi had never heard and by which we reached the lake on the second day out.

There we were courteously received and taken into custody by Captain H. G. Oldfield, D. C. of Baringo District. Our official status was that of trespassers, for we had entered a closed district without the permission of the provincial commissioner, whose residence we had passed en route at Nakuru; but no one could have imagined it from the manner of our reception.

Captain Oldfield, being engaged on one of the safaris required by his duties as British representative accredited to the Suk and other tribes in the northern province of Kenya, adjoining the Abyssinian border, was camped on the farther side of a river at which we paused to consider pitching our own camp. An askari waded the stream and brought me an invitation to have tea with the captain in his tent, and there my purpose was easily ascertained. Because of border fighting and possibly other difficulties regarding which I did not inquire, Baringo is closed to whites. Our apologies were, however, accepted, as was our suggestion that the captain should ride in General Buick while with us. We thus went on together the following morning to Kabarnet, the beautiful residency on the heights of the Kamisia mountains.

Kabarnet was selected as a residency site some years ago by Mr. Carewe-Read, now provincial commissioner, whose appreciation of healthfulness and beauty apparently overcame the objection of inaccessibility. It must have been a most arduous climb on the native trails up the rugged, forested range, and it remains a difficult one for motor cars by the only road yet constructed up the steep and stony ascent of thirty-three hundred feet from Lake Baringo.

British purpose is not easily daunted, however, nor even restrained by difficulties. The provincial commissioner now proposes a hospital at Kabarnet, in spite of water scarcity that would seem to bar such a proposal.

One may presume he intends to build another road than that by which we have come, since it is only twenty-odd miles along the summit of the Kamisia range to Eldama Ravine on the main road. But the water problem is giving Captain Oldfield grave concern. Obeying explicit orders to find water he had resorted to the time-honored but not infallible witch wand, and it, strange to relate, had turned strongly in his hands within fifty feet of the kitchen door, exactly where he wanted it to. There he had sunk a shaft to a depth of thirty feet in very hard rock, which was, unfortunately, discouragingly dry.

"What do you think of it?" he asked rather anxiously. I looked at the sieve of fissured rock and cast a glance into the valley to which the waters drained, far below.

"It may be one thousand feet to ground water, or possibly two," I answered.

That was after breakfast, as we strolled about the lawns and woods about the boma, which is located in a remnant of a grand old forest. It seemed to be up to me to help the captain, if possible, in his dilemma.

In ancient days, when no man dared to be incredulous and the witch wand competed only with prayers for rain, men had learned how to help themselves, even though the gods were ungenerous. The Tanks of Aden, built by a forgotten people, rebuilt by Romans, and repaired by British, demonstrate the antiquity of engineering as applied to water storage. The example appeared to me suggestive when, after the captain had gone to

meet visiting chiefs, I wandered with Solomon over the near-by hills.

At Aden the very peaks of pitiless rock that pierce the sky like teeth, where the hot breath of the desert cracks them, from time to time drink from the sea breezes. Deep in their clefts the gathered waters served Phœnicians and all navigators since.

At Kabarnet the clouds are far more generous, but the storage fails. From the rainfall data supplied by the captain I calculated that one acre of bare rock on a slope would furnish enough run-off to supply at least two Europeans with water for all purposes every year. If he would lay bare a sufficient number of acres by stripping the soil and would dig deep wells to store the rain, his problem would be solved. Fortunately the residency is situated just below an appropriate slope, where any number of acres may be stripped and whence the water would run downhill to the proposed hospital.

"We can get all the water we want," exclaimed the captain as we returned from a tour of inspection of the area I had reconnoitred.

Solomon little understood my thoughts as, standing on the highest outlook we could reach, I pointed out to him a faint blue streak on the flat northern horizon. It might be Lake Rudolph, I told him, a long lake past which lies the track to Abyssinia—the forbidden track and therefore the desired. It had been part of my original plan to pass through Abyssinia to the Red Sea, but the British

authorities politely made it plain that they would have nothing to do with an expedition across that boundary. Since the tribes acknowledge no overlord the only passport is a guard of at least fifty armed men, and even so an embarrassing "incident" might arise.

"Too bad," said I to Solomon, and he smiled sorrowfully in sympathy.

I studied with my field glasses the great Elgeyo escarpment that faced us across the profound valley of the Ndo river for more than fifty miles north and south. It is regarded as a cliff corresponding with a rift or fault. The eastern slope of the Kamisia range, up which we have driven, is also described as a fault face. Gregory says: "The western boundary fault [[of the rift valley]] in British East Africa bifurcates at its northern end and between the two branches stands the plateau of Kamisia" ("Rift Valleys and Geology of East Africa," page 215).

This illustrates how difficult it is to classify a feature of the landscape without introducing a hypothetical concept. Knowing Gregory's interpretation I have examined both sides of the Kamisia plateau and the Elgeyo escarpment carefully for evidence of faulting, but have failed to find the characteristic details. Rift escarpments where I have recognized them are characteristically straight and precipitous. They cut across the older structures. The fault face is more or less distinctly preserved, but in no case entirely eroded, and the streams

that course down the steep are poorly adjusted to the mosaic of the underlying terrane.

None of these characters is apparent in these slopes, high and bold though they are. The Elgeyo escarpment looks like the wall of the inner gorge of the Grand Canyon of the Colorado, which has also been described as the wall of a crack but is truly one side of an eroded stream channel. In each case there is the same upper element of the slope, a cliff in horizontally bedded rocks, and below is a grouping of spurs of greater or less length, definitely adjusted to the harder masses in the gneissic complex of the old crystalline foundation rocks. In the Grand Canyon the upper cliff is of sandstone; here it consists of lava flows; but in both instances the sinuous outline is the result of erosion, not of faulting.

The eastern slope of the Kamisia range, described by Gregory as a rift face, is beautifully sculptured. The scenery of forest and cliff and deep ravine is very impressive. One can imagine it the front of a broken mountain block. On more intimate examination, however, each cliff is found to be the eroded edge of a lava flow or the stripped surface of a dike or plug of volcanic rock, and the whole resolves itself into the sculptured face of the long extinct volcanic pile. I can find here no direct evidence of the great rift Gregory recognized.

There is, nevertheless, the obvious difference of level between the Baringo basin and the Elgeyo plateau, a difference of four thousand feet or more, which can have

resulted only from up or down movements of the two surfaces and the underlying blocks. Between the two there must have been a bend or a break, and to my thinking it does not matter whether there was a simple bend, a break, or any combination of the two mechanical effects, since I regard the difference of elevation as an effect of local vertical forces which have raised two masses to unequal heights. But Gregory's theory of horizontal tension and splitting requires the breaks he thought he saw.

Even the difference of vertical movement would require that the section between the Baringo basin and the Elgeyo plateau should have been stretched, and the condition of tension thus located would have favored the extrusion of the molten rock that now projects between the two and forms the Kamisia range.

Off to the east and southeast of Lake Baringo I could clearly distinguish the escarpment of Laikipia extending southward to the Settima scarp, and I knew there were others beyond. I could not approach them more nearly, but there seemed to be little occasion to do so. They are easily recognizable as cliffs due to fracture and displacement of the lavas, and constitute groups of step faults forming the eastern side of the rift valley. They can be traced on the topographic maps essentially in the relations described by Gregory, and I am again led to admire his powers of observation, though I do not follow his reasoning as to the mechanics of the faulting.

There is nothing in the steps themselves to distinguish a downward movement from an upward one of the terrace as a whole.

We regretfully bade good-by to our courteous host, Captain Oldfield, and returned by way of the deep basin of Baringo, as we had come. On the way down occurred one of those incidents characteristic of African streams. General Buick had crossed a dry river bed and Chev was following when a noise attracted the attention of the Arab driver and caused him to step on the gas. A wall of water and debris, the front of a cloudburst in the higher mountains, was roaring down upon him.

Lake Naivasha lies in a very shallow basin, of which it fills only the lowest portion. It is a shrinking, but pretty sheet of water in which stands a wooded, crescent-shaped island, the ridge of a crater. All around, at distances of a mile or more, low cliffs of dark brown rock encircle the gentle green slope. There is evidence that the waters once stood much higher than now and that the waves of the larger lake broke against rocky shores.

These differences of level of the lake are like those of others in this vicinity and of Lake Victoria, in that they are of very great interest to the students of climatic changes and of ancient man. It would seem that man of the stone age was here during thousands of years when heavy rainfall filled the basins, and witnessed the ensuing changes of climate. Geologists are not yet agreed how often thousands of years of rains have alternated with

The Great Rift Valley. Looking East across Lake Naivasha to the Aberdare Range.

like periods of dryness. In Europe man lived during the changes from glacial epochs to milder conditions and back to colder temperatures, as the climatic pendulum swung to and fro. There is a strong temptation to put the two histories side by side and to write the story of development of cultures as contemporaneous evolutions in Africa and Europe—a fascinating study, but one involving far more detailed investigation of the geologic facts and their relations to the deposits containing bones or artifacts than a passing traveler can attempt.

It has been suggested that lakes Naivasha, Elmenteita, and Nakuru are but remnants of a great lake that once extended far to the north beyond Baringo and to the south beyond Magadi. Sediments assigned to that lake are identified at high levels as well as in the basins, and their continuity at some previous common level is inferred. If this inference is correct it must follow that the differences of level have been produced during the later stages of the great lake's existence, or even that it was destroyed by the movements. Since the deposits contain human remains and tools it would be necessary to conclude that the faulting was contemporaneous with the presence of man during the stone age.

Bearing this suggestion in mind, I have searched on the slopes against which the waves should have broken and on the volcanoes that should have been islands, for shore terraces, for spits and bars, and for deltas at the mouths of the streams, but without result. There is nothing in

the rift valley to remind one of the superb shore features that remain around the basins of Lake Bonneville and Lake Lahontan in Utah and Nevada. Those lakes existed during the period in which this African lake in the rift valley is supposed to have had a similar extent. I find it difficult to believe that the latter could have left so little, if any, evidence of its shores.

An alternative explanation is that the rift valley, when man of the stone age occupied it, had already acquired a form approaching that which we now see, and that similar deposits of volcanic ash, diatomaceous earth, and volcanic soil from the older rocks were laid down on benches at different levels, whether in separate ponds or in swamps. Were a wetter climate to replace the present aridity, the conditions for similar, but separate lake deposits would soon develop. It seems probable that they existed at an earlier date, during the epochs of heavier rainfall, of which there is abundant evidence in equatorial Africa.

No one who has seen the terraces along the shores of Lake Victoria or those of the Kafu valley, described by Wayland, will doubt that there have been periods when the rainfall was greatly in excess of that which is now observed. The ancient outlet of Lake Naivasha would itself be sufficient to prove the change. The basin, having been dammed by the outflows of lava from Lonongot and minor volcanic vents, was filled to a level nearly two hundred feet above the present water surface and dis-

charged over the lavas, in which the river cut a broad canyon known as the Njorowa gorge. Where the canyon is a thousand feet wide there are along its sides deposits of gravel brought by tributary streams to the main river or arm of the lake. The latter flowed with very gentle current through this wide part of its channel, but quickened lower down. The volume of water was large and far beyond the amount that could be supplied by the tributary watershed under present conditions. Even a much heavier rainfall might not have sufficed without extensions of the watershed at which I can only guess. These are problems I must leave to others.

Captain Sikes and I have been over the escarpment west of Nairobi down into that section of the Great Rift valley where the Kapiri spring wells up under a bold cliff. It is the only permanent water for many miles around, and the Masai cattle tracks lead to it from every direction. Sikes camped beside it when he studied the district to find more water for the Masai and also to gather evidence of rifting to support Gregory's views. He succeeded in both objects. Two wells which he caused to be drilled yield as large a flow as could be expected, though the Masai ungratefully but naturally ask for more. As regards Gregory's theories, the rifting in the Kapiri valley is as characteristic an example of parallel faulting accompanied by the displacement of narrow blocks as one could find anywhere.

Descending into the Kapiri valley the road winds north and south between the higher fault blocks, passing around them at the ends. They present straight cliffs, a hundred feet or two in height, which form their sides and face each other across the lower blocks. The effect has been described by Gregory as a "grid," and I know no better term to apply, provided it be understood that there are few if any crossbars. It is a one-way grid.

Grids of parallel faults are characteristic of the floor of the Great Rift valley. The structure is strikingly developed in the Magadi district, where the houses of the Soda Works are strung along a black block, scarcely wide enough on top for two abreast, between strips of salt-covered plain—a pattern in black-and-white suitable for an aërial photograph. Far to the north of Kapiri, on the way to Baringo, we had zigzagged down similar fault scarps and recognized the displaced blocks of lava in the valley floor. They are well developed in the basin of Lake Hannington, to judge by the topographic map and descriptions of the barred landscape.

These grids are not only characteristic but significant. The long narrow strips, alternating in elevation, do not appear to have reached their relative positions by any method of unequal elevation. It is difficult to conceive an application of elevatory forces that would raise alternate strips higher than the intervening ones on so small a scale. It is not difficult, on the other hand, to imagine the valley floor in a state of unstable equilibrium and to

postulate that alternate blocks got jammed in higher positions as the whole subsided. This is the explanation offered by Gregory and it is sustained by the facts of faulting as well as by the reasonable inference that the volcanic foundations were unstable.

One sees faulting similar to that of the grids in the craters of Nyamlagira and Kilauea, where the surface has sunk in because the fluid lava underlying it found a lower outlet and left it unsupported. The parallel with the rift valley floor is not quite complete, but the idea is worth thinking about.

The first suggestion that occurred to me was that the grids had resulted from the withdrawal of lavas erupted from the neighboring volcanoes, Suswa, Lonongot, and others that stand in the valley; but the suggestion will not bear analysis. The volcanoes differ greatly in age. Some of them are older than the grids and have prevented the latter from extending, just as a knot prevents a split from growing in a plank. Where others, like Lonongot, are contemporaneous with or younger than the grid faulting the latter is very poorly developed, as in the section of the rift valley between Lonongot and Suswa. The relation between grid and volcano is something less direct, less obvious, possibly through a common cause of which there are different expressions.

Gregory and others have suggested that an arch of the breadth required to span the rift valley and of such height as the span would demand formerly stood over

the site of the present trough. I do not find this idea tenable. Between the Mau escarpment and the Aberdare range, the two abutments of the supposed arch in this region, the width of the span would be forty miles. On a moderate estimate the height of the arch would be fifteen thousand feet above the abutments, which are over nine thousand feet above sea level. Thus the arch would rise to more than twenty-four thousand feet. Considering that the length of the rift valley is six hundred miles this supposititious range challenges the record of mountain development.

Concepts of this grandeur seem simple, however, compared to that of the sinking of a Gondwana continent. If we would restrain the flight of imagination we must bring more obvious facts to bear.

"Sikes," said I as we crossed the escarpment at the upper edge of the long rise from Nairobi, "why is it that none of the roads into the rift valley, not even the railroad, has found a low pass over the rim? They all cross it where it is without even a nick."

He answered in effect that lower passes, if lower passes had existed, would no doubt have been found and used by the natives and by the whites who followed with road building. It was evident, as we both knew, that there were no such gaps in the rim.

Yet, if we visualize a mountain arch fifteen thousand feet high above the escarpment, we cannot conceive it to have been smooth, unscored by canyons, canyons deepest

toward their lower ends across the line of the escarpment itself. The collapse of the mountain would not destroy this evidence of its former height. Where was the evidence?

Or, assuming the improbable suggestion that the canyons might not have reached down to the line of the escarpment, where are the deposits of wash from the mountain, such as mantle plains along the base of every such range? Sikes could not tell me and possibly I left a doubt in his mind as to the former existence of that great super-rift himalaya.

I have waived good-by to Solomon, who has left to return to Dodoma and thence with his wife to their home in Nyasaland. He has been looking forward for several months to this opportunity, but whenever I have tested him by suggesting that the way was open he has looked a little sorrowful and bending his head to one side (a little habit he has when words to express his feelings fail him) has answered:

"When the Bwana goes home."

"What are you going to do now?" I asked him.

"I go back to mission school to learn how."

"How what, Solomon?"

"Reading, writing, and count . . . and . . . " he bent his head to one side. He was unable to express his desire, the desire to know, that had grown and grown as we wandered together through Africa.

"Good-by, Solomon."

"The map, Bwana?" Oh, yes. I had forgotten the map I had promised him on which he could show his friends all the long journey he had made. He took it eagerly.

I shook the strong black hand that has served me so well. He boarded the train, and the last I saw of Solomon he was leaning from the car window waving both arms in farewell.

Solomon takes his place as the representative of his race in a group of real men I have known: Paul Morrison, half-breed Ojibwa; "Billy" Driver, Irish prospector; Sam Crawford, Yankee sailor; Juan and Alejandro Torrentegui, Argentine gauchos; Li San, Chinese coolie; and Solomon Malakawala—all tried comrades on the long trail.

My work in Africa done, I am off by motor to Juba on the Nile and thence by rail and steamer to Khartoum, Cairo, and home.

SUDAN
ABYSSINIA
Lake Stefani
UGANDA
KENYA
Mt. Elgon
Lorian Swamp
Fort Portal
Mt. Ruwenzori
16700
Kumbala
Jinja
Lake Baringo
Entebbe
Mt. Kenya
Lake Edward
Mbarara
L. Nakuru
L. Elmenteita
L. Naivasha
LAKE VICTORIA
Nairobi
Mfumbiro Volcanoes
Kisenyi
Mara R.
L. Magadi
Bukavu
Orange R.
Lake Natron
L. Amboseli
Mwanza
Mt. Kilima Njaro
Mt. Ngoro Ngoro
L. Eyasi
L. Manyara
Uvira
CONGO
L. Jipe
Mombasa
Kigoma
LAKE TANGANYIKA
TANGANYIKA
Kabalo
Albertville
Map I
Dodoma
Zanzibar
Dar es Salaam
Ruaha R.
L. Kisale
L. Upemba
L. Kabele
L. Kabue
Mweru
Luapula R.
L. Mweru
Livingstone Mts.
LAKE BANGWEULU
Elizabethville
LAKE NYASA
NYASALAND
NORTHERN RHODESIA
Broken Hill
South Nyasa
L. Chiuta
L. Shirwa
PORTUGUESE EAST AFRICA
INDIAN OCEAN
Salisbury
Victoria Falls
SOUTHERN RHODESIA
Beira
Bulawayo

THE ANSWER?

GENEALOGY OF A THEORY

Suggestion, an eager boy, met
Credulity, a winsome maid, and begat
Plausibility, an enchantress.
Plausibility mated with a chance acquaintance,
Coincidence, and bore him
Belief, a stalwart youth, who set out to
conquer the World.
But across his shield was the bar sinister, for
Reason had not consecrated the union of any of
his progenitors.

And now that we have traveled many thousand miles in Africa, including two thousand among the rift valleys, have we any answer to the question that is stamped upon the face of the continent? It has grown to be a broader question than simply why are the rift valleys rift valleys? It is indeed why are the plateaus plateaus, even why is Africa Africa? It involves fundamental ideas of the earth's activity.

To those who adhere to the school of thought established by Suess on the concept that gravity is the strongest force of the earth, we must here say good-by. Our roads part, since the altitude of the plateaus above sea level is so great that it cannot have resulted from a subsidence of the latter. There are other time-honored ideas that we must leave behind

if we would keep abreast of truth: the old notion of a molten globe covered by a thin crust, and its corollary, the fascinating hypothesis conceived by Dana, that mountain chains are wrinkles on the surface of a contracting sphere. The globe is not molten as we used to think it, and there is no proof that it is contracting at a rate such that the shrinkage would account for the shortening up of mountainous sections.

The foundering of continental masses to the depths of ocean basins and the drifting of continents across the face of the globe find no support in the story of Africa, the most stable of all continents. These ideas also we must leave behind.

If we reason from the facts we shall more surely approach an understanding of the truth, but since the facts that we can observe are superficial and the causes are deep-seated the result must even so fall short of a conviction. As Gregory says in the preface to his work, "the Rift Valleys": "*This book will have failed in one chief purpose if it does not lead to the collection of further evidence as to the physical geography and geology of East Africa by those whose lot is cast in those most promising and pleasant of tropic lands.*"

The development of the African continent, from the earliest events we can ever hope to discover down through the ages to the present, has involved two dominant processes, elevation of the continental mass with reference to sea level and the intrusion of molten rock in large bodies rising from deep within the earth into the outer crust.

The proof of elevation during ancient times is seen in the rocks, in the manner of crystallization, in the minerals of which they are composed, and in the intimately crushed, contorted structures they exhibit. Even though they have remained solid during the processes of change, the old foundation rocks have been subjected to high temperatures and have moved under great pressures that can exist only at depths of many miles below the surface. Yet these rocks are now exposed at the surface. They have been uncovered and it is not difficult to understand how, since the process of uncovering is going on wherever winds blow dust away or rivulets and rivers take up sediment to carry it from the highland down to the lowland or to the sea.

The foundation rocks are exposed throughout Uganda, Tanganyika, and Rhodesia, wherever we have driven, and they also constitute the surface or lie not far beneath it throughout all Africa. Everywhere within the continent they bear witness to uplift.

The upward movements have been slow, but mighty. It takes power to lift a continent. That power has been applied gradually, beneath millions of cubic miles of the crust. It has continued to operate during repeated cycles, each one enduring not only through tens but hundreds of thousands of years. The force has waned and been renewed. After many millions of years it lifts the plateaus as of old, unabated in strength, slow but sure in action.

Whence comes that power, so widespread in effect, so often renewed, so unfailing throughout the ages?

More spectacular in appeal to our imagination, but actually less gigantic, is the upwelling, uppushing of molten masses from deep beneath Africa into its outer shell. Again and again they have risen toward or to the surface. The bodies that have reached the surface while still melted, though relatively small, are what we call "vast" lava fields or "huge" volcanoes. Far larger bodies, long since cooled beneath the surface, have become visible only when erosion has removed the covering rocks.

When we could readily, without proof or question, assume that these molten jets were fountains spraying from the liquid interior of the earth, neither their volume nor their repeated eruption called for explanation. But now that we have learned from the elastic vibrations of earthquakes that the earth is essentially solid, the molten masses present a real problem. They were solid; they melted. When melted they were squeezed out as from a bulb in the grasp of a powerful vise.

Heat, that fluent, wandering jinn, comes and goes throughout the globe. His birthplace is in the depths. He is born of gravitation and compression and lingers in the very core of the earth, melting it. Having become immensely powerful he rises toward the surface, but here and there, with unequal ease or difficulty. Where opposed in his escape he gathers strength, disturbs the age-old solidity of crystals, agitates them, and converts them into molten tongues, which are forced upward.

Whence came the heat energy? How was it concentrated? Why has it not been exhausted during the ages? Why did the walls of the crucible close in upon the melted rock and force it up to the surface? What relation has this heat activity to the persistently repeated process of uplift?

These are general questions, which are raised by all the continents, not by Africa alone. But each continent presents the questions in a form peculiar to itself, and the African form is the one with which we are concerned. The recent uplift of the African plateaus and the development of the rift valleys constitute the group of facts that we have to throw against the background of the ancient history of Africa as a relatively modern expression of the forces that have created and shaped the continent since the beginning.

Modern is a relative term and as applied to the age of the plateaus of Africa the period of modern times comprises much more than the history of man, even his most ancient history. The plateaus were already high, no doubt, when man of the stone age inhabited them. Geologists use a time scale that is immensely long. A geological day is five hundred years. It is on that scale that the uplift of Africa is modern.

Basing their chronology on the evolution of life, geologists recognize five great eras: the Azoic, or lifeless; the Archeozoic, ancient life; the Paleozoic, early life; Mesozoic, middle life; and Cenozoic, recent life eras. The probable duration of each older era was much longer than that of the succeeding one and the last two represent but a few million years in the billion and a half at which we now vaguely reckon the age

of the earth. Just when Africa began to form we cannot even guess, but it certainly was already a very, very ancient continent when the big reptiles roamed over it, kings of creation, in the Mesozoic era. And to that relatively modern time we may assign the beginning of the movements that have produced the African landscape we know.

We have then to deal with landscapes, the etching and engraving done by weather and by rivers upon the rocks that have reached the surface in one way or another. The rocks are etched chemically and the etched face is exposed by winds and waters; they are worn mechanically and the sculptured relief shows broad plateaus whose margins are cut by deep canyons, the initial work of rivers; elsewhere appear the softer, broader forms resulting from more prolonged reaction between the activities of the atmosphere and the resistance of the upraised mass of the continents. In these ways we may read the details of the uplifting of the land above sea level and gain some idea of how the forces have acted in producing the elevated continent, Africa.

Africa is remarkably flat. The flatness of Africa landscapes is in strong contrast to the mountainous character of European landscapes, and this at once suggests that the forces that have produced the one differ from those that developed the other. It is well understood that European mountain chains have been caused by local shortening of the crust, a result of horizontal compression. The general absence of similar ranges implies that horizontal compression has not been so effective in wrinkling the outer shell of Africa.

The flatness of Africa is the flatness of the oldest landscape that survives over wide areas in the continent. In Mesozoic time Africa was a great plain that sloped very gently to sea level. The climate was monotonously tropical within the tropics and nowhere modified locally by heights that concentrate rainfall. Rivers meandered sluggishly in courses that are now lost. The rocks beneath the plain were decayed to a depth of several hundred feet. The land surface was very old.

It had taken a long time—several millions of years—thus to level the continent down, and during that long period the mass had stood steady upon firm foundations.

It is true that prior to the development of the general plain there had been an uplift of perhaps a thousand feet in some provinces, as is shown by the residual hills that remain. We saw them south of Dodoma and in Northern Rhodesia, for instance. They are also conspicuous as the mountains of the southern Sudan, through which one passes in driving from Uganda to take the steamer on the Nile. But the tops of those hills, where they are extensive, are themselves flat and thus represent a still older plain, which in turn required a very long period to develop. That also was a period of stability.

Stability is the characteristic of the continent.

It was in approaching Lake Tanganyika in Northern Rhodesia that we first clearly recognized the landscape which was engraved upon the general plain when the continent began to rise in the movement that resulted in the present

high plateaus. That initial uplift was in general but a few hundred feet, though in places it may have been a thousand or more. It was widespread, however, and we have seen the mature landscape which represents it along the shores of Lake Tanganyika, as well as around those of Lake Victoria and in general elsewhere, wherever the older rocks are exposed and later more vigorous uplifts have not obscured the record.

Thus the first step toward the great elevation that has followed was a slight uplift and a pause of moderate duration, a few hundred thousand years.

Following that initial step came the far more effective exertion of the lifting forces, which warped the old plain, raised some areas more than others, and occasionally broke vertically through the outer shell. Along such breaks, where one side was raised more than another, rift faults developed and rift valleys appeared on the lower blocks.

That is the logical conclusion from the history of the landscape, and it is satisfactory so far as it goes. The rift valley of the Great Ruaha requires no other explanation. It is bounded on one side by the Fufu scarp, which is a vertical break such as would be expected from unequal elevation and which corresponds in trend with the planes of parting in the old foundation rocks. They stand on end and would naturally yield by slipping on the planes of parting. Across the Ruaha valley is the rise to the Iringa highland and there the surface is not broken, but warped into a broad flexure that sweeps from valley floor to plateau level, a

slope of three thousand feet. It is a pronounced example of the warping that has affected the plateau surfaces generally and is an effect of unequal elevation.

But although unequal elevation is a fact, and though it is observed that the different levels are connected sometimes by a slope, sometimes by a step, there are nevertheless other rift valleys which cannot be wholly explained simply as results of unequal elevation. Indeed only a small part of the valleys can be so explained. Let us turn to consider some other types.

The great Western rift shows evidences of horizontal compression throughout its entire length, from Lake Albert at the north to Lake Tanganyika in the south; and we may include the Rukwa rift and Mt. Mbeya. The adjacent plateaus are raised also. Thus these structures represent some combination of horizontal and vertical forces.

We noted some of the evidences of compression as we came along: the upthrust of Mt. Mbeya, the crushed zone on the south side of the Rukwa valley where the Trojan climbed the escarpment, the overthrusting seen by Teale and me in the gorge of the Nzasi river north of Kigoma, and the upthrusting of the escarpment above Lake Albert near Kibero. None of these structures are large features, so far as they are exposed to view, but they are no less significant as evidences of compression of the section of the crust in which they occur.

There are other results of compression which, if less directly observable, are more impressive because of their

magnitude. I refer to large blocks of the crust which, because they are wedge-shaped, have either been raised or depressed.

Wayland first published the idea that a mountain having a wedge-shaped bottom might be squeezed up out of the outer shell of the earth. He thus explained the elevation of Ruwenzori and the depression of the block underlying the trough of Lake Albert. That was in 1921 and he had, no doubt, been thinking about it as he studied the escarpments along the shores of the lake or tramped across the plains that surround Ruwenzori's heights. We reached the same explanation of the elevation of certain mountains in California about the same time. The idea was suggested to me by Nansen's description of his vessel, the Fram, which he designed of such a shape that arctic ice flows would slip under it and raise it, instead of crushing it. In the coast ranges of California there are mountains that are both crushed and raised. The two effects are logically related and their relation has been demonstrated in California so far as it can be by observations of the mountain structures on the surface and also in tunnels. That demonstration strengthens Wayland's interpretation.

Ruwenzori is the mountain which first suggested the idea to Wayland.

Two other mountain blocks that I have seen in Africa are best explained as wedges forced up out of the crust by compression. They are both in the coast of Lake Tanganyika. One is the long peninsula of Ubwari in the northern part of

the lake. It is thirty miles long and about four miles wide and rises on all sides very steeply from the lake level twenty-six hundred feet to a flat summit. The other is the Kungue peninsula, which stands out so unexpectedly from the generally low eastern shore. It is also about thirty miles long, but wider than the Ubwari block, being twelve miles across. The sharply sculptured summits rise also to about twenty-five hundred feet above the water.

Moving mountains is an ancient simile for an impossible task, yet here we have to consider not merely moving but lifting mountain blocks as a fact. The fact is evidence of a very great force, which not only astounds by its performance but also excites curiosity by its application around almost half a circle. The direction of pressure is northwest across the Lake Albert trough, west across Lake Tanganyika and south at Mbeya. One naturally turns to examine what has occurred on the other, the eastern side of the circle.

There we find the Eastern rift valley, curving in a shorter arc about the depression of Lake Victoria. It is especially characterized by the large amount of molten rock that has been forced up to and above the surface, as in the great volcanoes. I say forced up, because it does not appear that the heavy volcanic rocks could rise by their own lightness, even when melted, in balancing with the gneisses and granites through which they have risen. That they did so rise is a commonly accepted explanation, but it seems quite inadequate to have overcome the rigidity of the crust and

the friction. Pressure, it would seem, must have been exerted upon the molten masses in the pockets in which they were contained, and in raising great outflows of lava that pressure has done work comparable with the task of uplifting the solid masses of Ruwenzori, Ubwari, and Kungue.

Lines of pressure across the zone of the Eastern rift radiate northeast, east, and southeast. They thus measurably complete the circle of radial pressures, which includes those directed toward the northwest, west, and south. The arrangement is not exactly circular—the forms of Nature rarely are geometrical—but if we confine our attention to the area enclosed by the Eastern rift valley and that portion of the Western rift zone that extends from Lake Albert to Lake Tanganyika we have an approximately circular body four hundred and fifty miles across, the surface of which is a high plateau, the margins of which are raised, and in which the waters of Lake Victoria have gathered as in a saucer. Let us call this the Victoria disk. Around the outer rim of this saucer-shaped disk lie the upraised mountain blocks and the erupted molten masses, which are evidences of pressure exerted around that margin.

In order better to define the situation we need to make some assumption as to the third dimension of the mass under the saucer, its depth or thickness. Since it is four hundred and fifty miles across, it cannot be thin. A depth of at least thirty miles or, more reasonably, in excess of

fifty miles is indicated as the minimum thickness of the Victoria disk.

We might suppose, as some geologists presumably will, that the Victoria disk, four hundred and fifty miles in diameter and fifty or more miles thick, has been compressed from the outside by the outer masses around it moving in upon it. But in that case the outer masses should show effects of crowding into the smaller periphery, and the inner disk should be distorted more generally. The facts do not seem to fit that hypothetical case and we shall proceed more safely if we seek some cause of expansion of the disk, such that it can have exerted a pressure against the passively resisting bodies outside it.

We require a force which shall so act in the Victoria disk as to cause it to expand, much as a stove lid expands when heated. But this disk consists, not of castiron which expands considerably, but of crystalline rocks that expand relatively little. Heat expansion alone can hardly be regarded as sufficient to have caused the observed effects, yet some similar but more powerful action would produce the crushing around the margins. Let us consider the crystals themselves.

Crystals are hard, angular objects, the very symbol of rigidity as we usually see them. As such they interest chiefly jewelers and queens. But their rigidity is the balance of living forces, not of lifeless matter. They are storehouses of energy, which may be released when stimulated to action and which is capable of transforming a crystal most power-

fully. As such, crystals are among the most interesting of living things.

As geologists well know, crystals have a way of fitting themselves comfortably to their surroundings. When a molten rock cools slowly the crystals fit into each other to fill all the spaces and angles and, since the pressure in the liquid is the same in all directions, the crystals take convenient forms and places without any special arrangement. Look at a piece of granite. But if, deep in the earth, granite, after it has solidified, has been subjected to one-sided pressure and has also been heated and penetrated by hot vapors, the crystals rearrange themselves in the solid rock so as to take up less room in the direction in which the pressure is the greatest. At the same time they grow forcibly in directions at right angles to the greatest pressure. The rock then shows a definite grain along which it will split like wood. The common recrystallized form of granite, that is called gneiss, is a good example of such a readjustment of crystals to unequal pressures.

Now let us return to the Victoria disk enclosed by the Eastern and Western rift zones. We assume that it is composed of crystalline rocks, down to a depth of fifty miles or more. The molten rocks that have come to the surface in such large volumes along the Eastern rift valley and also in the Mfumbiro volcanoes of the Western zone show that a high temperature developed under the crust of this region. The temperature was locally high enough to melt the rocks which have appeared as lavas; elsewhere

around them and in notable masses it must have been high enough to cause recrystallization before any particular body could reach the melting point.

Now I think I begin to see how the heat engine of the earth works to displace mountains and cause rift valleys.

I assume that heat gathered underneath the solid Victoria disk and heated its lower portion. That would cause a certain small amount of expansion. As the temperature gradually rose crystals were stimulated to active life and change. They were under greater vertical pressure than that which pressed against them horizontally, as is normally the case in solid rocks at such depths, and they sought to arrange themselves in appropriate adjustment by growing thinner in their vertical dimensions and elongating horizontally. The change in any one crystal was very minute, but the sum of changes, added up from the central region outward, was great enough to expand the bottom.

The initial effect of the expansion of the bottom (in which the upper layers did not share) was to cup the disk and produce the saucer in which Lake Victoria lies. The more pronounced effect of prolonged heating and crystalline rearrangement has been to thrust up the plateaus along the edge of the Albert and Tanganyika troughs and to push up the masses of Ruwenzori, Ubwari, Kungue, and other sections of the solid margin. A similar effect might have been produced along the eastern side of the Victoria disk, but there pockets of lava had formed by melting and the expand-

ing disk pressed out the molten rock instead of crushing the opposing wall.

According to these deductions the great question mark on the face of Africa is an effect of heat which invaded the crust from below and, stimulating the crystals that compose the rocks at depths of thirty to fifty miles or more below the surface, caused the expansion of the under side of a disk within the curves of the Eastern and Western rift valleys. The superficial effects followed from that expansion.

We naturally speak in the past tense regarding these geologic activities, forgetting that in all probability they operate today quite as effectively as they ever have. Yet we are reminded of their reality when the earth trembles under the strain they impose. We say she quakes. Under intense pressure the masses are distorted and store up elastic resistance. They strive to slip but cannot until the friction is overcome. They then snap back into form and the elastic vibrations set up by their release travel far at high speed. The waves thus created are exaggerated at the surface of the ground and they shake our buildings down about our ears.

Along the zone of the Western rift valleys earthquakes are of common occurrence. They also occur along the Eastern zone of rifts, though perhaps less frequently or less severely. The difference in activity may be more apparent than real since movements sufficient to cause earthquakes might occur imperceptibly if they went on quietly, as they may in lava-

filled crevices. The elastic stress of a shock can be stored up only if there is friction between two masses that tend to slide past each other, and friction cannot develop on a rock bearing that is lubricated by lava. We know little, however, about the sequence of earthquakes along either zone, for our records cover a period much too brief to enable us to say how often or violent they may be and there is no native tradition regarding them. Earthquakes do not harm a man in the open; neither do they destroy grass huts. The instrumental records of the last thirty years suffice, however, to show that the forces are active and that the energy gathers from time to time with sufficient intensity to demonstrate the fact.

The continued activity of forces that appear to be both competent and appropriate to produce rift valleys should influence reasonable inferences regarding the origin of these peculiar features. We may not refer the mountains, plateaus, and valleys to some remote catastrophe, the subsidence of a hypothetical Gondwana land, for instance. We are face to face with a growing continent and must reckon with the conditions that now affect its growth.

It would seem that we have made a beginning of explaining the rift valleys, since we have found perhaps reasonable causes for some in unequal vertical movements and for others in local heating and recrystallization of the under crust. But there are further questions to be answered. For instance, what about the Eastern rift valley and the agree-

ment with Gregory's view that it exhibits effects of stretching?

A full statement would require a description of the successive events of eruption: how the lavas first rose into the outer shell and solidified it; how later eruptions swelled it up and broke it along the rifts; and how still later upwelling of molten rock raised the wings of the broken arch but left the central section at a lower level and traversed by the numerous faults of the grids.

This explanation agrees with Gregory's in that it recognizes the effects of tension, but differs from his in ascribing the local structure to local causes of commensurately moderate magnitude instead of to distant events of disproportionately great magnitude.

Another query to be put relates to the heights along the outer side of the Western rift. The farther side of Lake Albert is higher than that toward Lake Victoria. The western shore of Tanganyika is higher and bolder than the eastern. Can they be explained as effects of pressure exerted from the nearer side of the rift zone by the expansion of the Victoria disk, or should we look for a cause of pressure from the west? While undoubtedly the Victoria disk might in expanding develop sufficient molecular force to push blocks that underlie the Albert and Tanganyika troughs beneath the plateaus on their farther side and so to raise the latter, it seems reasonable to think there may have been an independent source of expansion and pressure in the west, under the Congo basin. The latter subsided deeply during

the early Mesozoic, and the Triassic sediments that fill it appear to have accumulated in a saucer that was both larger and deeper than that in which Lake Victoria now lies. The subterranean conditions may have been similar.

An even larger question stands waiting in the background. We have attributed certain minor rift valleys, such as that of the Great Ruaha, to unequal uplift and breaking of the crust with the development of steps. But one cannot rest satisfied without some explanation of the cause of elevation. Why have the plateaus been raised during geologically modern times after the continent had for much longer eras been stable on firm foundations? What change of conditions introduced beneath the continent the energy that sufficed to lift its surface?

There is a theory, known as the theory of isostatic balance, *which suggests that continents ride high because they are composed of lighter rocks than those that underlie the ocean basins. The latter condition is a fact and the tendency of the continental mass to rise to a position of equilibrium would be at its greatest after all the heights had been eroded, as was the case with Africa before the modern elevation began. But even so the difference of weight between equal masses of continental rocks and of suboceanic rocks is quite inadequate, in my judgment, to overcome the rigidity of the globe. No doubt the tendency to rise existed in the continental mass, but the most it could do would be to create an elastic strain between Africa and the bodies be-*

neath the adjacent oceans. We must look for some more powerful cause than this condition of a tendency.

Another theory involves changes of volume *of the solid crystalline rocks. It is established by observations on rocks that the chemical compounds of which they consist can adjust themselves to changes of pressure or of temperature or of both by changes of volume as well as by alterations of form. Larger volume would result if a mass of rock were heated and at the same time relieved of some of the load resting upon it. If we imagine this process going on beneath a continent that is being lightened by erosion we have a possible cause of uplift of the surface, since the increase of volume would lengthen the radii of the earth at their upper ends. It is difficult to weigh the significance of this suggestion, because we know so little about the reactions that may be possible among minerals under the extreme conditions of temperature and pressure at depths of fifty or a hundred or more miles below the surface. We shall eventually gain a better understanding of the behavior of rocks by experiments on them at high temperatures and great pressures in properly equipped laboratories, and the bold theorists who anticipate that knowledge may then be sustained.*

The isostatic theory rests upon measurements of the weight of continents in contrast with the weight of ocean beds, as determined by observations of the attraction of gravity and elaborate mathematical calculations of the relative intensities. The theory of volume changes is a result of microscopic chemical and physical investigations of

rocks in the laboratory. Another somewhat broader but less intimate line of investigation into the history of continents and the causes of their elevation is found in the study of ancient geography. Again let me hasten to say that I am using the geologic time scale, not the short measure of human history. The geographies of continents in the ancient and medieval periods of their long existence show certain parallels between opposite shores of any single ocean basin, whereas they display differences between the opposite coasts of any one continent.

Thus, nearly a hundred years ago English and American geologists discovered that the British Isles and parts of eastern North America have been covered by the sea during the same epochs of geologic history, and also that the lands had emerged from the sea and become mountainous during identical intervals. A similar parallelism of history is common to the lands that border the vast Pacific, but it is an historical sequence of events quite unlike that which is characteristic of the North Atlantic. Africa and South America, facing one another across the South Atlantic, show a similar parallelism of development, as has been brought out recently by the work of A. L. Du Toit, a South African geologist who attributes the likeness to a former close contiguity of the two continents. I, on the other hand, would infer that they had always formed opposite sides of the same ocean basin and consequently had suffered similar changes.

It is as though under each ocean bed there slept a giant whose long ages of undisturbed rest were occasionally broken. Slowly, sleepily stretching himself, he pushes away the walls that confine him. They may be walls within the ocean bed itself, for his reach may not be so wide as the basin; or they may be continental walls. He thrusts up a mountain ridge beneath the waters, such as lies under the Atlantics, or a great range of mountains along a coast, such as the Cordillera of the Andes. And what he does on his right he also does on his left, though not always to the same degree. He sleeps again and while he sleeps the lands which he raised waste away to lowland plains.

I said a giant. I should have said an army, a host. For the strength that we can invoke to do this work is the energy stored in millions of crystals, sleeping while bound in rigid balances of attraction and repulsion, waking to readjust the molecules to their environment.

They wake when warmed. They shorten vertically and elongate horizontally. And adding together their countless tiny efforts they push aside any adjacent masses of crystals which still sleep.

Where the wakeful hosts work near the surface, within ten to fifty miles of it, their effort thrusts up a mountain range. Where they become active a hundred miles or more beneath the surface they press against the foundations of adjacent continents and force the crystals which are there sleeping to bestir themselves, to seek better adjustments by shortening horizontally and elongating vertically upward in

the direction of least resistance. Their elongations, added up in vertical radii, raise the surface, and that is continental uplift. Africa is held between the hosts that lie beneath the Atlantic and Indian oceans. While they sleep it rests firmly upon its foundations. When they are wakened by the rising temperature beneath the ocean beds Africa is compressed between the two hosts of growing crystals, and the plateaus of Africa are raised to greater heights.

Lest some keen questioner be troubled that crystals should grow longer horizontally in the one case and vertically in the other, let us make it plain that crystals are almost human in that they always seek the easiest way out. Deep in any undisturbed part of the earth's crust the greater pressure comes from the weight of the overlying rock, and crystals find it easier to get out horizontally. But when they have been stimulated to the point that they release the molecular forces, they themselves exert a horizontal pressure that is greater than the load, and those crystals against which that pressure comes will grow vertically if they yield at all.

Over regions where crystals grow horizontally basins develop. Where crystals grow vertically continents rise.

It will not have escaped attention that very similar hypotheses are here advanced to account for the saucer-shaped basin of Lake Victoria and for ocean basins. There are certain similarities: deepening depressions in the earth's crust, marginal volcanoes, out-thrust of the margins and compression against the surrounding masses. The major

difference is one of size and, presumably, of depth of the underlying disk in which the forces are thought to work. Are these similarities suggestions merely, mere coincidences, or are they facts?

I am conscious of having found in earlier studies of ocean basins the clue to the explanation of the Victoria basin and the encompassing rift valleys. During several decades I have examined as dispassionately as I could the current hypotheses for the origin of oceans and continents, seeking always for an adequate cause: those which I found ready-made or which for a long time I could imagine seemed too superficial, too lacking in constructive energies for the work that has been and is being done. Discussions with T. C. Chamberlin turned my thoughts to deeper sources of energy, and other friends, among them Arthur L. Day and N. L. Bowen, unconsciously in friendly argument aroused that interest in the reactions of crystals under the wrestling influences of heat and pressure which has guided my later thought. Thus the theory that I entertain and have applied to the African problem has a certain past. Yes, it has a certain parentage. Suggestion and Credulity are mated, with the approval of Reason, I hope, and Plausibility, the enchantress, fascinates me. But I know not whether she will mate with Truth or with that gay deceiver, Coincidence, who has misled so many.

Plausibility still hesitates, but the trip through Africa has almost persuaded her. It has been a joyous companionship.

LOS ANGELES MUSEUM
EXPOSITION PARK

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